The Glass Industry
REG. U. S. PAT. OFF.

Vol. 9 MARCH, 1928 No. 3

Glass Division Active at Annual Meeting

American Ceramic Society

Members of the American Ceramic Society convened at the Hotel Ambassador, Atlantic City, on February 5, for the thirtieth annual meeting. The proceedings were opened by a reception held by President B. Mifl'n Hood and Dr. W. F. Demuth, president of the National Brick Manufacturers Association, whose forty-second annual meeting was held concurrently.

On Monday morning a general meeting took place and the proposed National Ceramic Council and other subjects of interest discussed. In the afternoon, the first of the various division meetings were held. The Glass division held several sessions, the last on Wednesday. On Thursday and Friday trips were made in buses to various ceramic plants.

THE SMILING GLASS DIVISIONERS, CAUGHT WHEN THE SHUTTER CLICKED, AT THE AMBASSADOR HOTEL

About 650 visitors were registered, of which perhaps one hundred were ladies. In the Glass Division the registration totaled 57 and a number of unregistered visitors attended the meetings.

The annual banquet was held on Wednesday evening.

A combined exhibition of ceramic materials was made, the largest of its kind yet attempted. It proved interesting to all the members

One of the best features of these meetings is the opportunity offered for good fellowship, renewal of old friendships and the making of new ones. A trite remark, but as true as ever.

Chicago was chosen as the location for the next annual meeting.

The election of general officers for 1928-1929 resulted as follows:

Officers for 1928-1929

President: Macdonald C. Booze, Charles Taylor Sons, Cincinnati, O. Vice President: R. R. Danielson, Metal and Thermit Co., Elizabeth, N. J. Treasurer: H. B. Henderson, Standard Pyrometric Cone Co., Columbus, O. Secretary: R. C. Purdy, 2525 North High Street, Columbus, O.

Officers were chosen for the Refractory Division as follows:

Chairman: L. J. Trostel, General Ceramics Co., Baltimore, Md. Secretary: C. F. Geiger, The Carborundum Co., Perth Amboy, N. J.

The Glass Division Meetings

Reviewed by
A. R. Payne
Fostoria Glass Company

Business Session

The officers of the Glass Division elected for the coming year were as follows:

For Chairman,—C. D. Spencer
For Vice-Chairman,—Dr. J. T. Littleton, Jr.
For Secretary,—G. W. Cooper

After the election of officers, the reports of the committees were heard, discussed and acted upon by the Division.

The Education Committee, represented by its Chairman, Dr. Alexander Silverman, brought to the attention of the Division the growing idea among graduate ceramic engineers that they had spent too much time while in school upon mathematics, chemistry, etc., and too little time upon business management and allied courses.

It seemed to be the general opinion of the Division that such opinions were not well-grounded and that no changes in curricula be advocated at the present time.

The Standards Committee, according to its Chairman, A. R. Payne, had been busy throughout the year. They have been working with the Bureau of Standards in the selection of glass and glass making materials for which standard methods of analysis were desired. They would prepare the sample and the Bureau would distribute it and collect the results obtained by the cooperating analysts. The Committee would then meet with Dr. Lundell of the Bureau of Standards and together they would select the best methods for accurate work in the glass laboratories throughout the country.

They submitted to the Division at this meeting the "Method for the Analysis of Glass Sand." Their method was adopted tentatively by the Division.

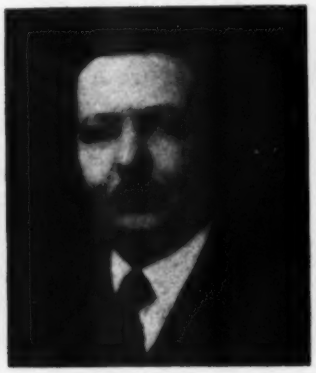
On Thursday, February 9, the members of the Glass Division took the following trip, Lester M. Moss and Herman K. Kimble acting as Chairmen. They went by bus to Vineland, N. J., leaving the Hotel at 8 A. M., Thursday morning, February 9. The following plants were visited:

Whitall-Tatum Company, Millville, N. J.
Tavern Rock and Sand Company, Millville, N. J.
T. C. Wheaton Company, Millville, N. J.
Kimble Glass Company, Vineland, N. J.
Vineland Flint Glass Works, Vineland, N. J.
Globe Thermos Bottle Company, Newfield, N. J.

Luncheon was arranged for at Vineland, N. J., and the bus returned to the Ambassador in time for dinner.

Officers of The American Ceramic Society, 1928-1929

MACDONALD C. BOOZE,
President



R. R. DANIELSON,
Vice-president

H. B. HENDERSON,
Treasurer

ROSS C. PURDY,
Secretary

Program

Contrary to the usual practice, the formal program of the Glass Division began at 2:00 P. M., Monday, February 6, with H. L. Dixon presiding.

New Method for Producing Refractories for the Metal and Glass Industries

By Henry J. Miller, Nela Park, Cleveland, Ohio

In this paper the author discussed the possibility of using certain aluminum compounds after fusion as refractories for the glass and metal factories.

The material is plastic and if the viscosity is right can be cast. It distorts under heat and pressure but will not break. Its use in glass making has been limited to a few trial melts in laboratories.

Determination of Iron in Glass Sand

By G. E. F. Lundell, H. B. Knowles,
Bureau of Standards, Washington, D. C.

Data were presented in tabular form showing the determination of iron in the Bureau of Standards sample of glass sand, No. 81. The electrometric titration method, the hydrogen sulphide reduction method, and the gravimetric method were described in detail.

The next glass to be issued by the Bureau with the cooperation of the Standards Committee will be a Lead Barium Glass.

Following that will be a fluorine opal glass which will be distributed.

Both of these glasses have been prepared and are in the hands of the Bureau at the present time.

After they have been analyzed, methods of analysis will be prepared by the committee and presented to the Division.

Later on more complex opal glasses may be attacked.

Note on Some Photo and Thermo-Chemical Changes in Certain Glasses

By A. Q. Toole and R. Stair, Bureau of Standards, Washington, D. C. (This paper was presented by Dr. Toole)

It was found that heat treating glass affected its dispersion and the transmission of the ultraviolet. When the color of glass had been changed by X rays or exposure to prolonged ultraviolet light the color could be regained by heat treatment. This heat treatment (100-500 deg. C.) will usually restore the color after it has been altered by radium radiations or ultraviolet light.

Curves were shown showing a great increase in the transmission of the ultraviolet as a result of heat treating. This increase is more and more pronounced as the temperature of the heat treatment approaches the annealing temperature.

This heat treating does not render the glass more resistant to solarization.

These measurements were made on cold glass after the heat treatment had been completed. There is only a small improvement in the transmission of the ultraviolet of non-solarized glass after heat treating.

Faraday's Researches in Connection with Glass Making

By E. W. Washburn, Bureau of Standards, Washington, D. C.

The efforts of Faraday to make a glass disc free from cords and seed were described. Cullet was melted in a platinum dish mounted in an iron box. It was stirred intermittently with a platinum ring and platinum sponge was added to absorb the gases.

The batch used in making the cullet taken was:

Silica, 1 part
Lead Oxide, 1 part
Boric Oxide, 1½ parts

The glass did not tarnish because no alkali was used.

Comparative Service of Refractory Blocks in Small Experimental Glass Tank

By R. F. Geller, W. L. Pendergast and Herbert Insley, Bureau of Standards, Washington, D. C. (This paper was read by Mr. Insley)

A very interesting series of experimental runs with a small tank was described and slides were shown which illustrated the corrosion upon the different refractories. These runs were a month each and the average temperature was 1425-1525 deg. C. From 9,000 to 13,000 pounds of raw batch were used in each run. Tanks were rated upon the way in which they resisted the corrosive action of the glass.

The best results were obtained from alundum and mullite blocks with small grain size. There was very little corrosion with these blocks, and the indications are that they would have resisted more severe furnace conditions.

Some Effects of Carefully Annealing Optical Glass

By L. W. Tilton, A. N. Finn and A. Q. Toole, Bureau of Standards, Washington, D. C.

This paper was presented by A. N. Finn. It discussed the variation of the physical properties of optical glass melts, particular attention being given to the index of refraction. There are variations in the index of refraction in some melts so great that the interchangeable use of the glass in the best grade optical instruments is not possible.

If the melts containing these variations is carefully annealed the index will become more uniform. Such annealing may take from 10 to 14 days.

In this manner the production of high grade photographic lenses may be improved and machine production substituted for some of the more costly hand work.

Life and Work of E. D. Libbey and M. J. Owens

By W. S. Walbridge and James Morrison, The Owens Bottle Co., Toledo, Ohio. This paper was read by Stanley S. Cline, The Owens Bottle Co., Philadelphia Pa.

It contained a very interesting account of the early life and work of these two great glass men and traced them through childhood and early manhood until fate brought them together. From the time their efforts were united fortune smiled upon them.

Success did not cause them to relax their efforts and death found both men actively engaged in directing the affairs of the two great companies with which they were connected and in bettering the city where they made their homes.

Glass Industry in Japan

By K. Fuwa, Tokyo Electric Co., Tokyo, Japan (This paper was read by Fred Thompson)

It dealt with the early history of glass making in Japan, tracing its development down to the present time. The oldest operating glass factory in Japan was built in 1820.

Since the opening of the ports foreign ideas have taken hold and all kinds of glass are now made with modern machinery.

Officers of Glass Division, 1928-1929

C. D. SPENCER,
Chairman

J. T. LITTLETON,
Vice-chairman

Influence of the History of Glass on Its Physical Properties

By Fritz Eckert, Technischen Hochschule, Berlin Presented by Henry J. Miller

For every glass there is a maximum temperature that should not be exceeded during the melting process. If this "optimum" temperature is exceeded the result will be brittle glass irrespective of its chemical composition or physical and chemical homogeneity.

Heat resisting glasses are more prone to be so injured than are others.

At times an increase of 30 deg. C. will ruin a given lot of glass.

This brittleness is noticeable in factory practice and is not a laboratory theory. It has been found in five different glasses by the author in factory operations.

NOTE—The opinions and conclusions of Dr. Eckert were questioned by memgers of the Glass Division as these differ so markedly from those customarily held. It was thought that physical inhomogeneities might have been the cause of the breakage.

Old American Alabaster Glasses

By Alexander Silverman, University of Pittsburgh, Pittsburgh, Pa.

The early history of alabaster glasses was given.

It was probable that the first alabaster glasses were opal glasses that were rendered pure white by coagulation of the particles. Probably this coagulation was caused by impurities in the raw materials used. These alabaster glasses were made about 1850 and were common prior to 1860.

About 1880 alabaster glasses went out of existence due to the increasing difficulty of making them with the purer raw materials which were coming into use.

In 1903 their manufacture was revived and impurities were deliberately added to glass batches to produce the effect that had first been gained by accident.

Properties of Cast Refractory Blocks and Suggestions for Installation in Glass Tanks

By G. S. Fulcher, Corning Glass Works, Corning, N. Y.

In presenting this paper Dr. Fulcher described to the glass industry a material which it has needed intensely for many years. It is probable that the development and use of Corhart refractories caused more discussion among the members of the Glass Division than any other subject brought up during the meeting.

The following abstract touches the high spots in Dr. Fulcher's paper.

In November, 1926, an announcement was made that the Corning Glass Works had developed a new refractory made by a method new in ceramics, which gave blocks of maximum density and zero porosity. Instead of being dry pressed and burned, these blocks were produced by melting aluminous silicious material in an arc furnace and pouring the molten refractory material into a suitable mold of the desired shape.

When the blocks are being poured, the liquid stream is at a temperature of about 1,900 deg. C. (3,450 deg. F.). The material on cooling has a dense interlocking crystalline structure free from interconnecting pores. As would be expected from the crystalline structure and zero porosity, these blocks have shown remarkable resistance to corrosion by molten glass. This was illustrated by some of the results of tests which had been made previous to the announcement. Tests made since the announcement have further confirmed the conclusion that of all glass refractories so far produced cast refractory of the proper composition is the most resistant to corrosion by glass.

Fig. 1 shows the bridgewall of a bulb tank of the General Electric Company, at Niles, Ohio, ready for a run. There are two throats formed of superior clay blocks, and between these is a 48 inch panel of cast blocks. Fig. 2 shows the same bridgewall after a run of eleven months. Note that each throat has been eaten away upward about two feet. At the glass line the attack on the cast block is only one-third that on the adjacent flux blocks and below the glass line the relative attack is even less. Fig. 3 shows a bridgewall in a fruit jar tank of the Hazel-Atlas Glass Company, at Washington, Pa. This bridgewall is built entirely of cast blocks. It is 36 inches thick and solid for the lower 24 inches. A 36 inch block spans the submerged throat. Fig. 4 shows the same bridgewall after a run of 7 months during which 7,000 tons of glass were pulled through the throat. The blocks are evidently still in excellent condition. At the glass line the attack is only 3 inches while under the ports the clay side wall blocks were eaten back over 11 inches. The most remarkable result, however, is the small attack on the throat cover block. Comparison of this result with the effect of a similar run on the clay throat blocks in the Niles tank shows the striking superiority of the cast material. This bridgewall is evidently good for at least two more runs, without repairs.

Tests in window glass tanks have given equally satisfactory re-

FIG. 1—THE BRIDGE WALL AND THROAT BLOCKS OF THE BULB GLASS TANK OF THE NILES DIVISION OF THE GENERAL ELECTRIC COMPANY AT TIME OF CONSTRUCTION. THE CENTRAL PANEL MARKED C IS MADE OF CORHART BLOCKS. THE REMAINDER OF THE WALL IS A HIGH GRADE CLAY BLOCK.

FIG. 2—THE SAME BRIDGE WALL AFTER ELEVEN MONTHS' OPERATION. THE THROAT BLOCKS HAVE BEEN EATEN BACK NEARLY TWO FEET.

FIG. 3—THE CORHART BRIDGE WALL, BUILT ENTIRELY OF CAST BLOCKS, AND THROAT OF A BOTTLE GLASS TANK OF THE HAZEL-ATLAS COMPANY AT THE TIME OF CONSTRUCTION. (SEE FIG. 4.)

sults. At the Adamston Flat Glass plant in Clarksburg, W. Va., fifty blocks were put in at a hot repair, so as to form an upper course 8 inches high and 12 inches wide beneath the ports and around the end of the tank. As a result a life of 10 months was obtained, fully twice the usual life, and a much longer life would have been obtained if the clay bench blocks beneath the cast blocks had not been corroded away below the cast blocks.

One more test will be mentioned which shows even more strikingly the great superiority of the cast blocks to high grade clay blocks. In a tank of the Hocking Glass Company, at Lancaster, Pa,. two 24 inch panels of cast blocks were placed between the first and second ports, one on each side of the melting chamber. third design (c) has the further advantage of eliminating the horizontal seam at the bottom of the tank, leaving only the horizontal seam below the top course. This construction has not actually been tried in service, but from such results as the Hocking test, it seems highly probable that with this design the top course will last at least two normal fires and the bottom course and bottom blocks at least four normal fires, so that after two fires it should be necessary to replace merely the top course.

It should be pointed out that because the bottom cast blocks are inside the lower side wall course, unless precautions are taken, the bottom blocks on expanding will push the side blocks out. To prevent this, it is suggested that expansion joints be left in the

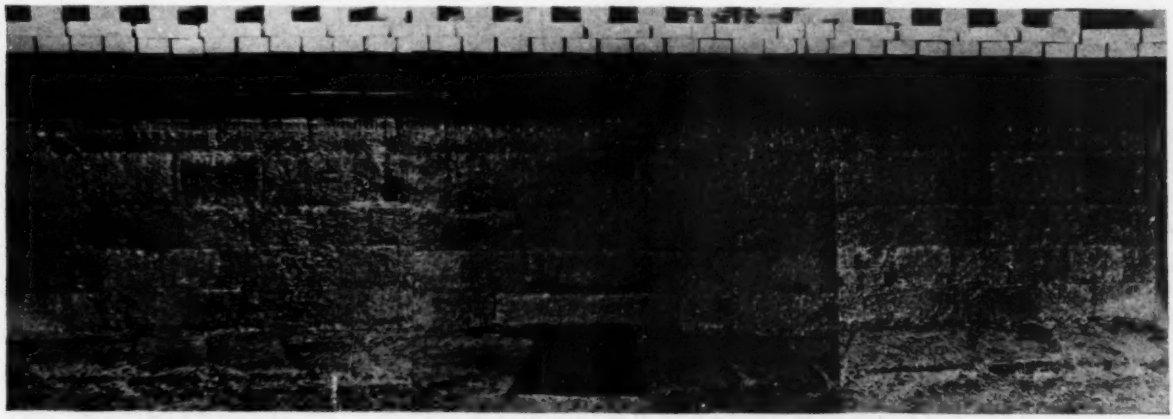
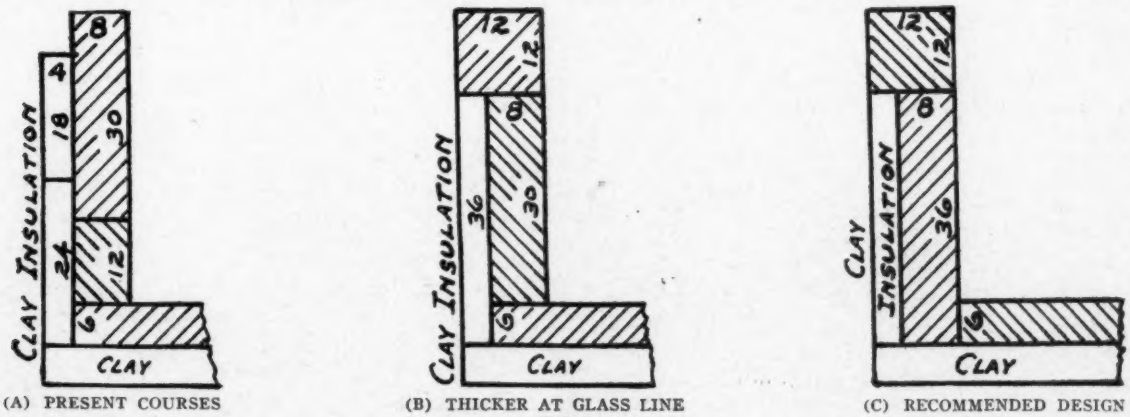


FIG. 4—SAME WALL AS FIG. 3
After a run of 7 months during which 7,000 tons of glass was pulled throughthe throat.

(The attack after a run of eleven months is shown on page 44, February issue.) While the clay blocks are so far gone as to necessitate replacement, the top course of cast blocks is good for at least one more run and the lower courses are good for several more runs.

Now as to the design of walls and throats made of cast blocks. It will be noticed that the attack in cast blocks in lime glass, both bottle and window glass, is most severe at the glass line and upward from a horizontal seam. Even at the bottom of the wall, the horizontal seam is attacked. These results lead to two conclusions, (1) the thickness of refractory at the glass line should be a bottom, about one inch to ten feet. If this is done and if the tank is brought up to temperature empty so that cold cullet will not get in these joints, there should be no trouble due to expansion of the bottom. The advantages of running the side blocks down outside the bottom blocks seem well worth any extra trouble necessary in heating up the tank.

Next was shown a suggested design for a standard throat of cast blocks, composed of standard sizes of cast blocks. The throat opening is 12 inches by 24 inches by 48 inches, giving a 24 inch air-space. This may be reduced to 18 inches if desired by allowing the throat cover blocks to project 3 inches at each end. A



(A) PRESENT COURSES (B) THICKER AT GLASS LINE (C) RECOMMENDED DESIGN

FIG. 5

maximum and (2) horizontal seams should be eliminated as much as possible, including the seam at the bottom corner between the wall and the bottom. Another fact to be kept in mind in designing walls built of cast blocks is that the thermal conductivity of the cast material is from two to three times that of fire clay.

Fig. 5 shows various designs for the walls of a bottle tank 42 inches deep. The first section (a) corresponds to present practice with clay flux blocks, except that only 8 inches of cast material is used, backed by 4 inches of clay to reduce the heat loss, except at the glass line. The second design (b) has the advantage over (a) of providing 12 inches of cast material at the glass line. The standard subway throat has been designed, also made of standard size blocks. This design gives 24 inches of cast material over the throat.

A standard flared dog-house, using standard flared corners has been made. The width may be made 24, 30, 36 or 48 inches at the narrow end. Standard rectangular dog-house corners are also furnished. In order to take care of circular noses, it is planned to furnish standard circle blocks with a 15 deg. taper, using 12 for a semi-circle. By interposing rectangular blocks of various widths, circles of any desired radius can be built.

There has been some discussion as to whether it pays to use

superior tank blocks. Assuming that a cast tank built according to design (c) will require the replacement of only the top course and throat and dog-house corners after two normal fires, and that the lower course of side blocks and the bottom blocks will last four normal fires, the tonnage required for the melting chamber and throat of two typical tanks with melting chambers 16 by 20 feet and 20 by 45 feet and 42 inches deep, has been computed for a clay tank and a cast tank. The results are given above.

For a melting chamber 16 by 20 feet inside:

	Flux Tank	Cast Tank	
	Clay flux blocks	Cast blocks	Clay blocks
Initial (complete repair) .	45.0 tons	41.6 tons	17.5 tons
After one fire	19.2 tons	No repair	
After two fires	45.0 tons	13.0 tons	partial repair
After three fires	19.2 tons	No repair	
Total for four fires	128.4 tons	54.6 tons	17.5 tons

For a melting chamber 20 feet by 45 feet inside:

	Flux Tank	Cast Tank	
	Clay flux blocks	Cast blocks	Clay blocks
Initial (complete repair) .	97.0 tons	86.0 tons	40.0 tons
After one fire	31.6 tons	No repair	
After two fires	97.0 tons	18.5 tons	
After three fires	31.6 tons	No repair	
Total for four fires	257.2 tons	103.5 tons	40.0 tons

These figures show that the tonnage of cast blocks required with this construction is only half the tonnage of flux blocks normally required. Moreover, because of the fact that the cast blocks do not require cooling and the cast tank needs to be brought up only half as often as the flux tank, there is a saving of from $3,000 to $5,000 per fire so that the direct cost of the cast tank (including only cost of blocks, cost of heating tank and cooling cost) comes out thirty per cent less than the direct cost of a clay tank. In addition this saving of 30 per cent, there is the indirect saving due to fewer shut-downs and the saving due to lack of stones in the glass. In many cases these last two items will exceed the cost of the cast blocks.

Data on Tank Block Wear

By D. W. Ross, Findlay Clay Pot Co., Washington, Pa.

Some very interesting slides were shown which illustrated the modern ideas about tank construction. The one course blocks showed superiority over the two course type. Overcoat blocks, which are hard burned flux blocks applied over the weak places which appear in the sides of the tank, appear to be better than water coolers.

The desirability of deep throats was emphasized. These should have a wide fore-bay and there should be considerable depth of block over the sunken throat.

It appears probable that the most fatal period of heating up tank blocks is between 1,200 deg. and 2,200 deg. F. Tanks are ordinarily brought up by merely heating the tank chamber proper and then starting reversing the fire through the checkers when the temperature in the tank chamber has reached 1,400-1,600 deg.

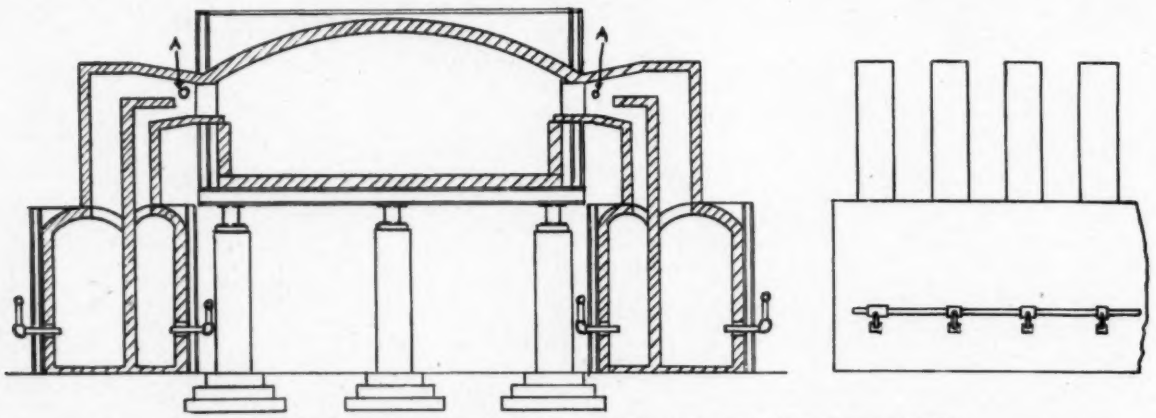


FIG. 1—GENERALIZED CROSS SECTION OF TANK AND SIDE VIEW OF CHECKERS
Showing manner of introducing gas at bottom of checkers for heating up of tanks to avoid sudden temperature changes between 1,200 and 2,200 deg. F.

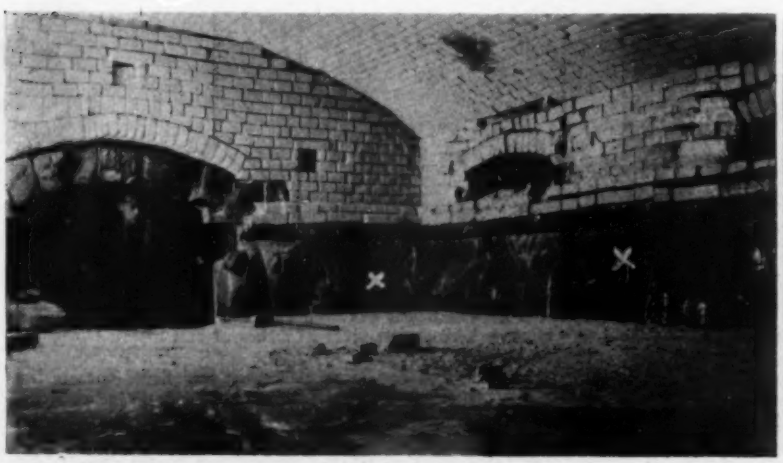


FIG. 2.—TANK THAT CRACKED IN HEATING UP
"X" marks designate where upward eating took place from cracks through the blocks. This tank was operated approximately eight months.

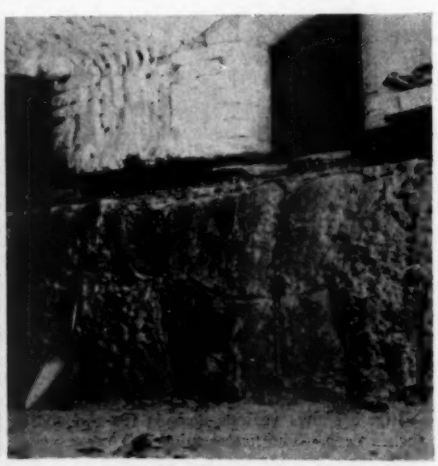


FIG. 3—THIS TANK DID NOT CRACK IN HEATING UP
Note the good condition of the blocks after twelve months' service at 2,650 deg. F.

Starting with reversing cold checkers in this manner usually results in changes of a hundred degrees or more in the tank chamber during one complete cycle of reversing.

Such large variations in temperature at this critical period of tank heating appears to be ruinous to the flux blocks of which the tank chamber is constructed, causing them to crack badly.

On the other hand, if the tank is heated by gas lines in the bottom of the checkers as indicated in Fig. 1, these sudden changes of temperature through the critical range of 1,200-2,200 deg. is avoided to the very great benefit of the blocks. Auxiliary burners in the sides of the ports as indicated at "A" may be used if desired.

As the temperature rises above 2,200 deg. the blocks soften appreciably so that the strain is in a measure relieved, with the result that the blocks are less likely to crack.

Glass Manufacture in Brazil

By H. Haynes, Fabrica Mazda, Rio de Janeiro, Brazil.
This paper was read by Jack Waggoner.

A lengthy description of the early glass making in Brazil together with a history of the expansion of the industry and the troubles encountered by the early pioneers in that field.

A resume of the number of factories in operation at the present time and their equipment, number of employes, quantity of production, etc.

Supplies and Equipment Shown

The exhibition of ceramic supplies and equipment was the largest ever held in connection with a Society meeting and attracted much attention. Exhibits of special interest to the glass trade were:

H. L. Dixon Company, Pittsburgh, Pa., glasshouse equipment and supplies. Vanad mold castings.
Golding Sons Company-Erwin Feldspar Company, Trenton, N. J., feldspar.
Corhart Refractories Company, Louisville, Ky., cast tank blocks.
Roessler & Hasslacher Chemical Company, New York, colors and chemicals.
Foote Mineral Company, Philadelphia, Pa., minerals and chemicals.
Vitro Manufacturing Company, Pittsburgh, Pa., colors and chemicals.
Johns-Manville Corporation, New York, heat insulating material.
Brown Instrument Company, Philadelphia, Pa., pyrometers, heat control.
New Castle Refractories Company, New Castle, Pa., refractories.
American Dressler Tunnel Kilns, Inc., Cleveland, O., tunnel kilns.
The O. Hommel Company, Pittsburgh, colors and chemicals, etc.
Mutton Hollow Fire Brick Company, Woodbridge, N. J., refractories.
DeVilbiss Company, Toledo, O., color sprayers.
Binks Spray Engineering Company, Chicago, Ill., color sprayers.
The Bristol Company, Waterbury, Conn., pyrometers.
Leeds & Northrup Company, Philadelphia, Pa., pyrometers.
River Feldspar Company, Middletown, Conn., feldspar.
Clinchfield Sand & Feldspar Corporation-Oxford Mining & Milling Company, Baltimore, Md., feldspar.
Tinius Olsen Testing Machine Company, Philadelphia, Pa., testing machines.
The Pyrometer Instrument Company, New York, pyrometers.
E. J. Lavino & Company, Philadelphia, Pa., minerals.
Celite Products Company, Los Angeles, Cal., Sil-o-cel, etc.
American Gas Association, New York.
Carborundum Company, Perth Amboy, N. J., refractories.
Robinson Ventilating Company, Zelienople, Pa., wind systems, etc.
Carrier Engineering Co., Newark, N. J., drying systems.
The Clark Tructractor Co., Battle Creek, Mich.

Registration of Attendance

Members attending the sessions of the Glass Division

H. H. Blau, Macbeth-Evans Glass Co., Charleroi, Pa.
A. T. Houser, Woods-Lloyd Co., Pittsburgh, Pa.
T. W. Hoyler, Roessler & Hasslacher Chemical Co., New York.
W. Malsch, Roessler & Hasslacher Chemical Co., New York.
T. P. Knight, Jr., Lime Chemical Products Co., Spruce Pine, N. C.
G. S. Fulcher, Corning Glass Works, Corning, N. Y.
A. E. Williams, Hartford-Empire Co., Hartford, Conn.
C. D. Spencer, General Electric Co., Cleveland, Ohio.
W. F. Dingley, Pacific Coast Borax Co., New York.
J. F. Greene, Kimble Glass Co., Vineland, N. J.
J. C. Hostetter, Corning Glass Works, Central Falls, R. I.
C. H. Kollstedt, Public Service Corp. of Northern Illinois.
M. R. Scott, Bausch & Lomb Optical Co., Rochester, N. Y.
J. C. Kurtz, Bausch & Lomb Optical Co., Rochester, N. Y.
J. F. McClain, Harrison Glass Works of G. E. Co., Harrison, N. J.
W. V. Brumbaugh, National Lime Ass'n, Washington, D. C.
Harlan S. Miner, Welsbach Co., Gloucester City, N. J.
J. A. Kayser, Laclede-Christy Co., Rochester, Pa.
R. O. Smith, Salem, N. J.
C. E. Fulton, Pittsburgh Plate Glass Co., Creighton, Pa.
E. W. Washburn, Bureau of Standards, Washington, D. C.
C. J. Uhrmann, Inland Glass Co., Chicago, Ill.
G. V. McCauley, Corning Glass Works, Corning, N. Y.
W. K. Brownlee, Buckeye Clay Pot Co., Toledo, Ohio.
Alexander Silverman, Univ. of Pittsburgh, Pittsburgh, Pa.
W. R. Malkin, B. F. Drakenfeld Co., E. Liverpool, Ohio.
E. L. Hettinger, Willson Goggles, Inc., Reading, Pa.
L. C. Roche, Maryland Glass Corp., Baltimore, Md.
H. L. Dixon, H. L. Dixon Co., Pittsburgh, Pa.
A. N. Finn, Bureau of Standards, Washington, D. C.
James Gillinder, Gillinder Bros., Port Jervis, N. Y.
J. L. Crawford, Laclede-Christy Co., St. Louis, Mo.
P. H. Bates, Bureau of Standards, Washington, D. C.
F. C. Flint, Hazel-Atlas Glass Co., Washington, Pa.
C. W. Parker, Mississippi Wire Glass Co., St. Louis, Mo.
C. B. McComas, Carr-Lowrey Glass Co., Baltimore, Md.
T. F. McNeal, Carr-Lowrey Glass Co., Baltimore, Md.
L. R. Milford, Solvay Process Co., Syracuse, N. Y.
G. M. Walter, Illinois Glass Co., Alton, Ill.
C. S. Linder, Pittsburgh Plate Glass Co., Creighton, Pa.
D. E. Sharp, Hamburg, N. Y.
H. J. Miller, General Electric Co., Cleveland, Ohio.
A. Q. Toole, Bureau of Standards, Washington, D. C.
A. R. Payne, Fostoria Glass Co., Moundsville, W. Va.
R. F. Brenner, Owens Bottle Co., Toledo, Ohio.
C. E. Reed, Sharp-Schurtz Co., Lancaster, Ohio.
G. E. F. Lundell, Bureau of Standards, Washington, D. C.
M. G. Babcock, Pittsburgh Plate Glass Co., Pittsburgh, Pa.
L. M. Moss, General Electric Co., Harrison, N. J.
W. L. Brownlee, Buckeye Clay Pot Co., Toledo, Ohio.
W. E. Dougherty, O. Hommel Co., Pittsburgh, Pa.
G. W. Cooper, THE GLASS INDUSTRY, New York.
S. R. Scholes, Federal Glass Co., Columbus, Ohio.
H. Insley, Bureau of Standards, Washington, D. C.
J. H. Waggoner, Mellon Institute, Pittsburgh, Pa.
W. F. Curtis, Fostoria Glass Co., Moundsville, W. Va.
G. Lufkin, Illinois Glass Co., Alton, Ill.
J. T. Littleton, Jr., Corning Glass Works, Corning, N. Y.

What the Glass Section Will See in England

Through the courtesy of the Society of Glass Technology of England an itinerary has been arranged for the pleasure and profit of glassmen making "The Ceramic Tour," during the ten days between their arrival on June 21, this year, at London from the "Hook of Holland," and their departure for their homes across the ocean on June 30.

A cable from Prof. W. E. S. Turner on behalf of the Society of Glass Technology to H. L. Dixon, chairman of the Glass Division, read at the Atlantic City meeting, expressed the hope that many American glass men would visit England this spring, and gave assurance that all would be welcome.

THE COMPLETE PROGRAM

THURSDAY AND FRIDAY, JUNE 22. Group A—Gen'l Electric Co.'s Research Laboratory, Wembley and General Electric Co.'s Glass Works; James Powell & Sons, Harrow; United Glass Bottle Manufacturers Ltd., Charlton, Rockware Glass Syndicate Ltd. Group B—Doulton's Pottery Works. Group C—Visits to brick works. Note: The visit to Harrow may possibly be combined with a visit to Harrow school.

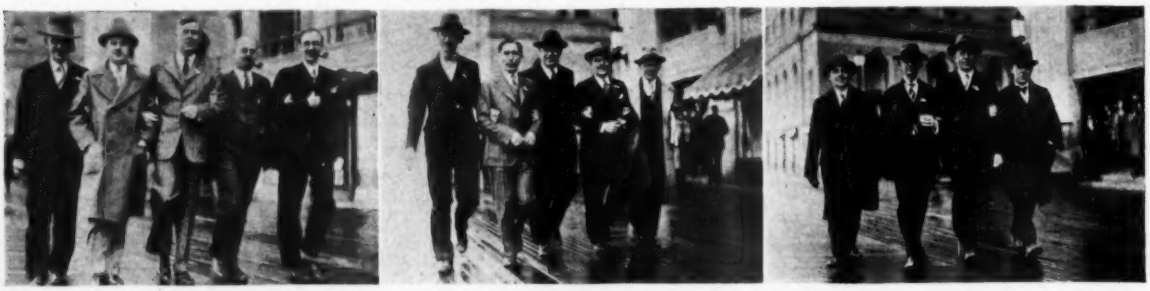
FRIDAY EVENING, JUNE 22.—Banquet.

SATURDAY, JUNE 23.—Sightseeing. Party for St. Austel China Clay Mines to leave Saturday night by train.

SUNDAY, JUNE 24.

MONDAY, JUNE 25.—Those not taking the trip to St. Austel will travel to Oxford for lunch or Stratford-on-Avon for tea, thence to Birmingham where they will stay overnight.

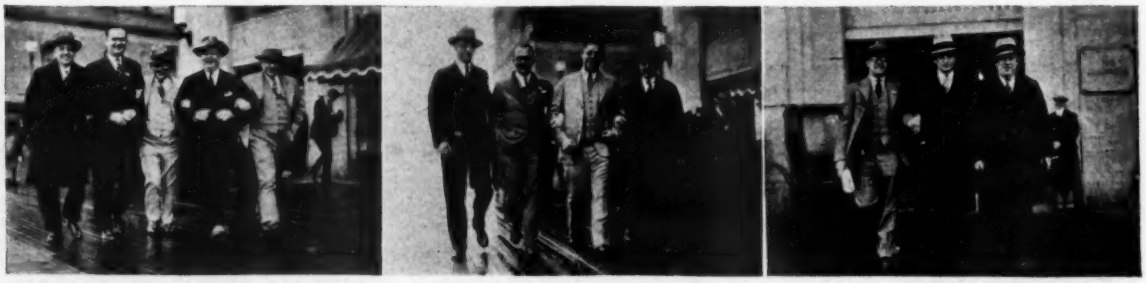
TUESDAY, 26.—Party A. Leave for Worcester to see fine art



BETWEEN THE SHOWERS

THE INFORMAL PARADE OF THE GLASS DIVISION

DRIFTING DOWN THE BOARDWALK WHEN THE CLOUDS HAD CLEARED AWAY



porcelain works; thence to Stoke where party from Cornwall will rejoin group. Party B. Visit Stourbridge and glass works also fire clay refractories, on to Stoke for the evening. Party C. Visit Burton on Trent and sewer pipe works and thence to Stoke.

WEDNESDAY, 27.—Visit Dr. Mellor's laboratories and the pottery works. Dinner by National Pottery Manufacturers Federation.

THURSDAY, 28.—Party A. (Glass) Leave Stoke in A. M. by way of Buxton, Bakewell (Haddon Hall) and Rowesley (calling at Peacock Inn) to Sheffield. Afternoon visit to Department of Technology. Party B. (Refractory) Either travel with party A, or call en route to visit works of Messrs. West thence on to Sheffield by same route as Party A. Party C. (Pottery) Visit to works in Stoke during morning. Journey to Sheffield by motor by same route as party A. Arriving early evening. Evening: Reception by City and University.

FRIDAY, 29.—Visits to works selected from following:—1. British Thomson-Houston Company, Glass works, Chesterfield,—Wood Brothers Glass Co., Ltd., Barnsley, John Lumb & Co., Ltd., Castleford, Hailwood & Ackroyd, Ltd., Morley. 2. A. representative silica brick works. 3. Leeds Fireclay Company, Ltd., Leeds 4. Department of Fuel, Leeds. Evening: Dinner by Society of Glass Technology and Refractories Association. Depart for Liverpool.

SATURDAY, 30.—Sail for United States.

The Design of Plate Glass Polishing Machines

By F. W. Preston[1]

Part II of the article written by Dr. Preston at the editor's request, to explain the principles underlying the mathematical theory given in his paper of the same title published recently (June, 1927), in the Journal of the Society of Glass Technology. Part I was published in the February number. Part III will appear in an early issue.

The Laws of Polishing

Let us examine the laws of polishing so far as we know them, and see what we can do toward making uniform the Rate of Polishing, or what causes that rate to be non-uniform in existing machines.

There is a good deal of evidence that over a wide range of conditions the amount of glass removed is proportional to the amount of "work done" or "power consumed." Thus thirty or forty years ago it was customary to spend eight or ten hours in polishing, while we now spend but one, but we have not appreciably reduced the total power consumption. We use more power for a shorter time, instead of a little power for a long time. In kilowatt-hours we use much the same power as ever we did. This seems to be inherent in the physics of the process. In current plate glass work it takes nearly half a kilowatt-hour to polish a square foot of glass. This is somewhat higher than obtains in the optical glass industry, but is of the same order of magnitude.

I have myself polished large slabs of glass very perfectly in from five to ten minutes. All that was necessary was an immense concentration of power. Similarly certain microscope lenses and even tolerably large photographic lenses can be polished in a few minutes, provided they are of such a shape and robustness that the heat of polishing does not distort or break them.

The condition that the rate of polishing should be proportional to the "work done" is principally that the polisher shall be in good condition, properly loaded with rouge, not too wet and not too dry.

Now consider a polishing operation carried out on an old fashioned "square" table (say) with a strip of felt 18 inches by 1 inch for polisher, as in Fig. 1.

The polisher would be somewhat awkward to use, but it could be made, and if it would hold a satisfactory face of rouge, it would work.

In Fig. 1 suppose the polisher is originally at AB at one edge of the table, and that it is moved across the glass once to A′B′. The pressure is uniform along the length AB of the polisher, and it remains constant as the whole thing is moved across to A′B′.

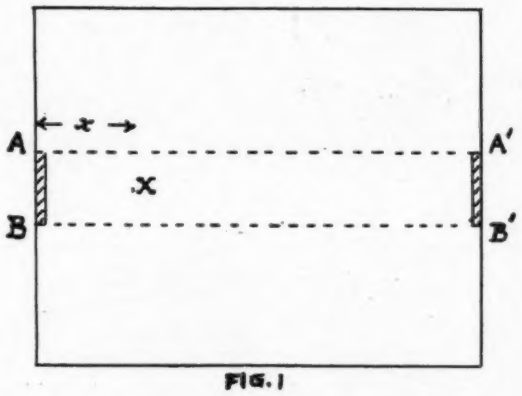


FIG. 1

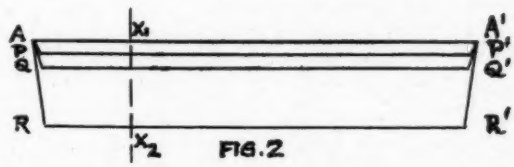


FIG. 2

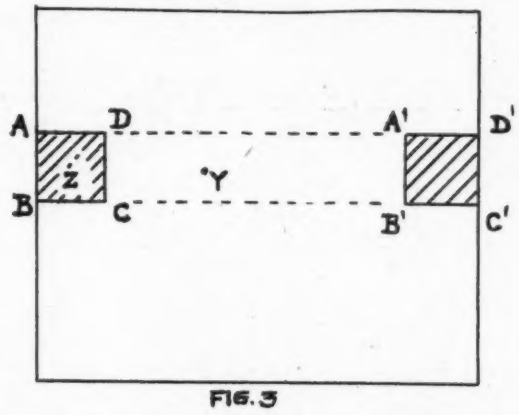


FIG. 3

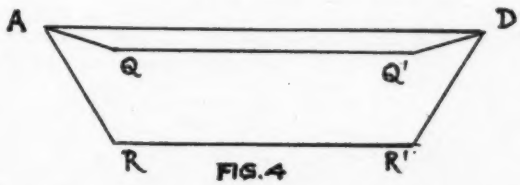


FIG. 4

Then every part of the glass that is passed over by our curious polisher receives the same treatment as every other part that is passed over. Every part gets very slightly polished—an insignificant gloss appears; a tiny quantity of glass is removed.

In Fig. 2 let AA′ represent in cross section the original surface of the glass. Then after the polisher has passed over, this surface is worn down a millionth of an inch or so. We may represent this in an exaggerated fashion in Fig. 2 by the line PP′, which represents the new surface.

Now drag the polisher back from A′B′ to AB. It does a little more polishing, removes a little more glass, and the surface is worn down to Q′Q.

We may repeat the process time and again and ultimately

[1]Consulting Engineer, Leicester, England, and Butler, Pennsylvania.

our surface is worn down to RR′. The figure AA′ R′R is called a polish-distribution diagram. A point X in Fig. 1 distant x from AB, is represented originally by the point X_1 in Fig. 2, and finally by point X_2 in Fig. 2. The distance X_1X_2 represents the amount of polish that has been effected at point X. In technical language we say that a

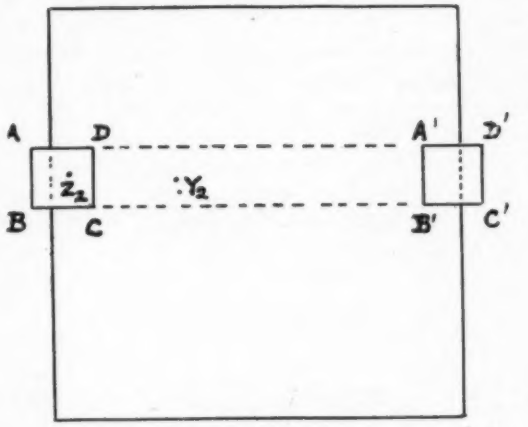


FIG. 5

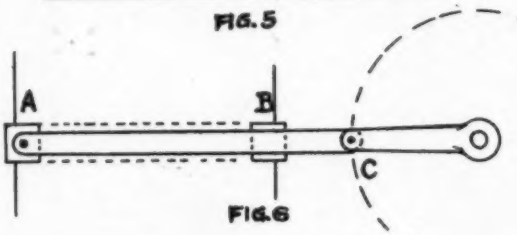


FIG. 6

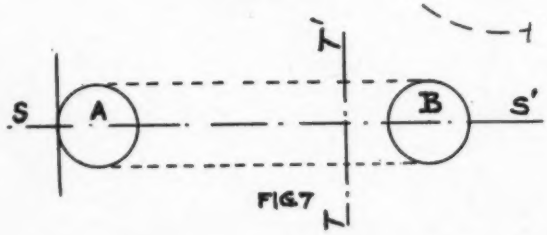


FIG. 7

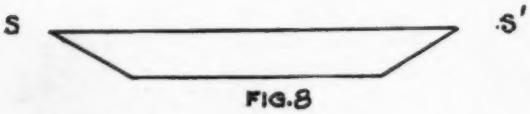


FIG. 8

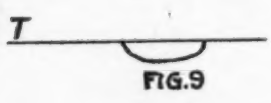


FIG. 9

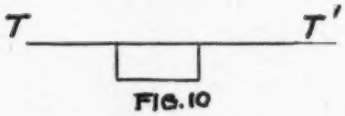


FIG. 10

polish distribution diagram is a figure (like Fig. 2) in which abscissae or horizontal distances (AX_1) represents points on the deck, while ordinates or vertical distances (e.g. X_1 X_2) represent the amount of polishing done, that is, the amount of glass polished off, at such points on the deck.

Now Fig. 2 is an ideal sort of diagram, because the Rate of Polishing is everywhere the same. A machine built on this principle would be ideal so far as evenness of polishing is concerned, but mechanically it would be troublesome, and the polishing though uniform, would be slow.

Suppose next that instead of a narrow strip of felt we use a square of felt, say 18 inches square as in Fig. 3 and that we move it from the position ABCD to A′B′C′D′. Then the distribution diagram is as in Fig. 4. After one pass we reach QQ′, and after a certain number we reach RR′.

All points on the deck in the rectangle DA′B′C in Fig. 3 receive equal amounts of polish, but points nearer the edge than this, for example points in ABCD get less polishing. At the extreme edge there is no polishing at all.

To remedy this difficulty we may let the felt overlap the edge at each end of its stroke, as in Fig. 5, and then, if the overlap be correct and the weight of the block properly distributed over the felt, the distribution will again resemble Fig. 2—as a first approximation at least.

The reason that we do not get uniform polish with the arrangement of Fig. 3 is that such a point as Y is crossed

FIG. 11

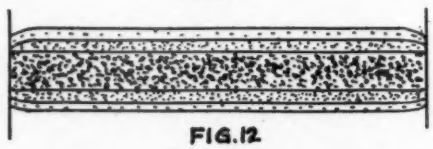


FIG. 12

by the whole width of the felt at every stroke, while such a point as Z is crossed by only about half the felt. Some of the felt never crosses Z at all.

It may be objected that the same thing is true of a point like Z_2 in Fig. 5, and the reason that Z_2 gets a fairly good polish is that as the felt overlaps the edge of the table the weight per square inch on that part that stays on the table increases, so that although Z_2 experiences the rubbing of less than the normal amount of felt, yet such felt as does cross Z_2 crosses it for the most part under an abnormally high pressure. This helps to make up for the deficiency in feltage, and so point Z_2 may polish as fast as Y_2, or in certain cases even faster.

Now it is worth noting at this point that it does not matter how fast or how slowly we move the felt across the glass, provided of course that it doesn't "chatter" or tilt, but moves with a good steady grip. All that matters is how many passes we make. It is obvious that if we move it across speedily, we may get in twice as many strokes to the minute as if we move slowly, and then we shall polish twice as fast; but there is no use increasing the speed unless we do so for the purpose of getting in a greater number of strokes. The amount of polish is the same per stroke whether we go fast or slow.

The important point about this is, of course, that the stroke may vary in speed from start to finish without affecting the distribution diagram. For example in Fig. 6 we

might move the felt from A to B by a motion of the crank C, so that A and B are "dead centres" with the felt moving slowly, while in the middle of its journey the felt crosses the centre of the table at a goodly speed. Nevertheless, the distribution diagram will be just the same as in Fig. 5, where we supposed the felt to move at a uniform speed from side to side of the table.

Such a crank motion is said to be "harmonic." With an infinitely long connecting rod AC it becomes "simple harmonic," or it may be made "simple harmonic" by other mechanisms. A "simple harmonic" motion does away with the bump and shock of stoppage and reversal that a uniform motion (such as we postulated in Fig. 1, 3, or 5) experiences at each end of the travel. A brilliant and unusual embodiment of the best features of this harmonic motion with approximately uniform polishing is that of James Carrie (U. S. Patent No. 1,375,129, etc.).

But the felts of actual practice are circular, or rather they make contact with the glass over a circle, and not over a square.

Suppose we let a circular felt move from position A in Fig. 7 to position B.

Then along the section SS′ the distribution curve will be as in Fig. 8, which is the same as if the felt had been square; but along the section TT′ the distribution diagram plots as in Fig. 9, while a square felt would have produced Fig. 10.

The distribution-curves are the same shape as the channels or grooves gouged out by the polisher, except that they are greatly exaggerated in depth. Hence a contoured plan of the hollow or groove left by the polisher would look something like Fig. 11, where the darker shading indicates greater depth or greater polish.

With felts overlapping the edge we get some such distribution as in Fig. 12.

[Part III will appear in an early issue.]

Inspiring Meeting of Container Men at Washington

Secretary Hoover Addresses Glass Container Association

There was an excellent attendance at the meeting of the Glass Container Association held February 2 and 3 at the Mayflower Hotel, Washington, D. C. Upwards of one hundred names were registered.

An interesting program including a very special number, an address by Secretary Hoover of the Department of Commerce, was carried out. The Secretary spoke of the tremendous improvements made in production and marketing methods during the past few years and commended the trade associations for their splendid work along this line. He said that Government approval of and co-operation with such organizations would continue so long as they adopt no illegal practices. He was given a very cordial reception.

Frank F. Ferguson, president of the Association, opened the first session. He emphasized the fact that the meetings of the Association are open to anyone interested in glass. He introduced Dr. K. P. Meyer, canning expert of the State Board of Health of California, who has acquired the reputation of doing more for the cause of pure food properly packed than anyone else and who gave the members much valuable information relating to his subject, "The California Canning Inspection Service."

C. R. Stevenson, president of the National Association of Cost Accountants, spoke on "The Economic Effect of Taking Business at or Below normal Cost." He referred to the increasing complications of the last few years, caused largely by the overbuilt condition of the industry and the increased production capacity resulting from improvements in bottle making equipment. Mass production implies mass consumption, but the present demand for bottles is not proportionate to the increased manufacturing facilities. Tremendous drives have been made to lower costs, but profits have not been commensurate with reductions in cost, and the profit trend has been downward. Other industries are in a similar position, the speaker said, and citied the United States Steel Corporation.

He declared that a continuation of price-cutting practices would be fatal to individual enterprises and to the whole industry. He referred to a questionnaire distributed among manufacturers, the returns from which indicated that 25 per cent of them would not hesitate to cut prices below cost if they thought it necessary to get the business, regardless of the effect on the industry as a whole. An additional 50 per cent said they would, if necessary to keep their men employed, take orders at cost but not below cost. The final 25 per cent does not believe in price-cutting at all.

Mr. Stevenson pointed out that if, in order to lower his costs, the glass manufacturers compel the producers of raw materials and supplies to quote prices that make transactions unprofitable, he is merely helping to reduce the public's purchasing power and therefore that of his own market, a policy that in the long run is bound to be disastrous.

Among the other affairs considered on Thursday and Friday was the report of Fred J. Rummel, statistician, on operating conditions in the container field. He reported that new orders received in the last quarter of 1927 equalled those of previous years. A comparison of conditions in other industries is not unfavorable to glass. Investigation shows, however, that the demands of all markets do not exceed 80 per cent of the industry's production capacity. Shipments during the past year were 6.93 per cent greater than in the previous years. February is now the leading month for obtaining new orders. The factories are now operating to only 72 per cent of their capacity, and cost calculations should be based on that fact.

"Contingencies in Glasshouse Costs" were discussed by E. G. Ackerman, who emphasized the fact that the manufacturers, in figuring costs, should never depend on records

or estimates that fail to include all overhead expenses, losses and depreciations from whatever cause, otherwise they are standing on sunsafe ground. True costs, he pointed out, are not made by taking the actual cost over a limited period but are rather a reflection of the actual cost plus the contingent cost over a period long enough to give all the variations in manufacturing and a normal figure that can be used for selling prices with perfect confidence that costs will be recovered over a sufficiently long period of time. He stressed the importance of including contingent cost factors in total costs and in averaging contingent cost factors over a period sufficiently long to permit the reflection of normal costs in the cost of production over any period of whatever length.

J. C. Magness, traffic director, stated that freight rate adjustments are still being delayed but at an early date new rates bringing relief to shippers will be published.

One of the features of the meeting was W. K. Brownlee's contribution under the title "Glass and Clay," a very interesting review of the refractory situation. It is abstracted at length in this issue.

He suggested the organization of a committee of eight or more—three glass men, three from the clay division and two physicists, to work in some factory to be arranged for, on the problems of glassmaking which an individual concern cannot undertake, the losses, if any, to be divided among all of the beneficiaries.

Mr. Brownlee, who is a manufacturer of refractories himself, takes a broad-minded attitude towards the new competitive refractory materials recently placed on the market. He stated that until further developments occur the manufacturers of the old type of block will have to be conservative in building up stocks. His paper appears in this issue.

George Roth, of the Harvard University Committee on Economic Research, made an optimistic address on "The Business Outlook."

Howard W. Dickinson, former vice-president and general manager of George Batten Company, Inc., spoke on "Promotion," and I. R. Stewart, chairman of the publicity committee, submitted to the members "A Statement of the Publicity Situation."

Lieutenant-Governor F. Harold Van Orman of Indiana was programmed for an address on Friday, but owing to the death of his father could not attend the meeting. A message of condolence was dispatched to him.

Before closing the Friday meeting the glass container manufacturers discussed the necessity for closer co-operation between themselves in matters affecting their interests. James Morrison, of Owens Bottle Company, strongly urged concerted action and moved the appointment of a committee consisting of W. H. Boshart, of the Owens Bottle Company, W. E. Levis, of the Illinois Glass Company, J. H. McNash, of Hazel-Atlas Glass Company, and H. C. Mandeville, of Thatcher Manufacturing Company, to devise ways and means for improving trade conditions. The motion was seconded by P. I. Heuisler, of Maryland Glass Company.

It was decided to invite W. H. B. Whitall, of Whitall-Tatum Company, and H. D. Hartley, of Turner Glass Company, to join the committee and to issue one additional invitation later. It is believed that this action will inaugurate a new era in the Association's affairs.

Arrangements to hold the 1929 annual meeting at the Traymore Hotel, Atlantic City, about April 26 have been made subject to change in plans.

A milk bottle cap section of the Association has been organized, also an investigation of packing methods and costs will be made.

A suggestion that one of the Association's meetings be held in Cincinnati, Ohio, was received.

Glass and Clay

By W. K. Brownlee*

The problems that I have had to meet in the glass industry had to be considered within the possibilities of clay and the details of furnace construction.

It was in 1889 I was first elected to help construct a glass factory, and all of my time since then has been employed in matters pertaining to the glass industry. In 1889 I could not visualize the future, but in 1928 I can look back and see the evolution of the manufacture of glass, from pot furnaces to tank furnaces, from all hand-made ware to semi-hand ware, and then to automatic or machine-made ware.

Environment, opportunity or chance placed me in the heart of the development work from one process to the other with the Owens Industries and the Libbey Glass Manufacturing Company. This development work required a departure from the old standard clay accessories and in 1909 The Buckeye Clay Pot Company was formed and located in Toledo, where new clay pots could be quickly prepared to facilitate the development work. This soon became a very small part of our work and we entered into the tank block field.

In the years between 1912 and 1917 there were not such high tonnages required from furnaces as there have been from that time up to the present. All sorts of speeding up schemes have been employed to increase production. In the period when 25 to 30 tons of glass were required from a furnace with 17 feet of area per ton of glass, it was not uncommon to run furnaces two and one-half years. Two or three in one plant, to my knowledge, ran three years.

Shorter Life of Tank Blocks

Mechanical methods of making glassware in those days were in their infancy. Engineering forces became very ambitious and were encouraged to develop greater speed through one application or another until furnaces were soon melting 100 per cent and over more glass than their areas provided for, and then all at once, the block manufacturers began to fall down on the quality of blocks, or so it would seem, just like one might expect a 5-horse power motor to stand up under a 10-horse power load.

The block manufacturers were very much worried over this until the correct analysis was made of the situation. Just recently I saw records covering the last six or seven years and it is surprising but true that furnaces are producing practically the same tonnage of glass today running 12 to 14 months as they

*President of the Buckeye Clay Pot Co., Toledo, O. Presented to the Glass Container Association at Washington, D. C., on February 7, 1928.

did when they would last 30 months or more, so the determining factor is the load. If you buy tires for your car, you do not measure the time they last, you look to the mileage. It's up to you whether you take the 15,000 miles out in six months or one year. It is no different in glass making. If you exceed the furnace capacity you sacrifice its running time, so far as the walls of the furnace are concerned, and then we resort to some artificial means of prolonging the life of furnaces.

The older method of doing this was more and more wind. This is being displaced generally by water patches and it is not an uncommon thing to see these plastered all over the sides of furnaces, and I am strongly of the opinion that if the cost of these patches and the water used were considered plus the alarming hazard that is present (for if anything happens to the water supply there is sure to be a serious loss), it would be far cheaper to increase the furnace area to 18 feet per ton rather than continue this practice.

If you get the area large enough, and I am sure that 18 feet is ample, then you can, by insulation, effect economies in fuel that will surprise you. The economy will not only be reflected in your fuel bill, but in the quality of your ware.

Complete insulation will eliminate almost entirely viscosity differences. Through the diversified movement of certain areas of the glass body, the time factor for melting and plaining up the glass is probably one-fourth of what the theoretical time should be; so thin walls or walls that are excessively cooled bring the force of convection about in such a way that the unmelted materials are taken away from the position they should occupy and this retards the speed of their dissolution.

Theory of Insulation

This theory of insulation is so opposed to the cooling practice that it is usually discredited so completely that it does not get up to a serious analysis.

Let me try to show what heat does to clay and then keep thinking about this theory.

We will start with making glass in covered pots. In this method of making glass we build a clay crucible that holds from 2,500 lbs. to 3,000 lbs. The walls and bottom are about 4 1-2 inches thick, the walls are about 34 inches high and the crown is tapered to about 2 1-2 inches. They are put in a furnace and they begin to function as a glass melting apparatus. In this process of melting glass we impose a barrier of clay between the glass material and the heat supply and we depend on thermal conductivity through this barrier to melt the batch and refine it.

This process of melting glass produces the big factor of heat treatment of clay to withstand corrosion, namely, the impervious or vitreous condition; the clay structure becomes immune to the absorption of the alkali which is the destructive element, and, if the best care is used during the plaining period of each melt, it is possible to get many months' life out of a pot. Not infrequently a year or more on soda-lime glass, and then a physical examination will disclose the fact that the pot did not wear out where the heat was the most intense. The cause of failure is usually found in the bottom, where the vitreous condition did not obtain or at some point or points in the walls where the many fillings of cold batch had set up shrinkage cracks which eventually penetrated through the entire wall. You must judge then the resistance to corrosion by the sections of wall between the cracks, and the slight attack shown is due to heat treatment.

Now if we were of the opinion that we should use a higher fusion clay in pots, say a clay that would have a melting point of 200 degrees higher than our standard pot-clay, then we would have to operate at a 200-degree higher temperature to condition the clay to the vitreous point. I have made many laboratory tests of this theory and know it to be correct.

I conclude then that glass making temperatures are not destructive to the clays we now use in the manufacture of glass. On the contrary they are about right to properly condition such clays to resist corrosion, and I have used the pot system to show the wide comparison between pots and tank practice.

In glass tanks we ignore the benefits of heat treatment and spend money in any direction that offers a cooling medium on the outside of tank blocks, and a corresponding amount in the form of more fuel inside of the furnace. In doing this the vitreous condition becomes impossible to obtain and the excess temperature causes the alkalis to be more limpid, penetrating and destructive to the wall material in its unvitrified condition.

Unless physical laws are disregarded entirely, convection currents are set up by cold walls that bring the batch in its lowest viscosity to the walls and down them, and it is in this condition that the alkalis in the batch are the most destructive. What we should strive to do to make glass in a tank of the best quality, uniform viscosity, and at the least cost, is not to interfere with the natural growth of specific gravity and obtain the longest time factor that a furnace capacity will allow, from the raw batch to the finished condition and this time factor can be increased approximately 400 per cent in most cases. This means a lower and less destructive melting temperature, and will furnish more glass than can be taken out of the furnaces under present conditions.

Heat Treatment of Tank Blocks

The heat treatment of tank blocks is a matter that will require some experimental trials, to determine just where the general results will be the best obtainable. We just recently fired a kiln of blocks to cone 16 which is 2642 F. These blocks were 12 inches thick, 24 inches wide and 50 inches long, and I felt very confident that we would have no difficulty in reaching the temperature we wanted. We held the temperature for 30 hours and then we discovered we had caused the supports under the blocks to partly collapse and our loss was 50 per cent of the contents of the kiln. I am not discouraged over this feature so much as on other phases of the trial, one of which is the final dressing to size when burned so hard.

Other experiments show that if we properly insulate the blocks they will take on the necessary heat treatment and this is by far the most simple way as the workable condition is not destroyed. I conclude that tank blocks can be burned to cone 14, which is 2570. Then after the furnace is under fire for 24 hours at cone 16 we may begin to fill in the batch.

In a test furnace which we operated just a year ago for 60 days we insulated first with fire brick, then outside the fire brick a course of C 22 Silocel brick, then two inches of Johns-Manville Super Ex. Our heat loss through this was reduced to 90 degrees on the outside with the operating temperature on the inside 2642 for 30 days and 2700 for the last 30 days.

If I were not convinced that the whole scheme is sound and proven so by results shown I would not be an exponent of the theory. In fact until 1923 I strongly conformed to the "more cooling" theory on tank blocks and I hope I have given you sufficient reason why I do not conform to it now.

Within the last few years there have been some very interesting papers on faults in glass, the flow of glass in continuous tanks, varying changes of viscosity in tanks, the heat flow in tanks, tank block corrosion, etc. The work of these writers can be compared to the work of our diagnosticians, so we human beings may know that there are complications in our system that are undermining our health, and we must do something to counteract them or be quite satisfied to pass on.

Suggests Co-Operative Research in Glass

Technical men are not contributing their work to any individual. Their work is for the interest of all concerned and it would be a very simple matter if all who are concerned would provide some subject to operate on. For instance, could a committee of eight or more men, three to be from the glass division, three from the clay division and two physicists, work out a comprehensive program of development work that could be carried out in some particular furnace, say in a factory that has furnaces waiting for seasonable business.

If this committee could agree on one particular thing that would be useful or beneficial for the good of all, and all agree to share in the loss if any, then in three or four years things could be accomplished that would not be undertaken by the individual, just the same as this "Buy in Glass" campaign is being conducted.

I make this suggestion merely to bring out the idea of concerted action. The question of cost is liable to influence us against any departure from established practice. There must be a reasonable assurance that if our initial cost is higher, we may expect a substantial return in the net result.

We have an example of two day-tanks in which their output was increased 100 per cent at 150 degrees lower gas temperature due to insulation, and these are the factors of economy that produce the net gain even though the initial cost is somewhat higher.

The point is this, they are able to operate under lower tempera-

tures, which, of course, are not so destructive to the furnace structure.

The Newer Refractory Materials

On the question of new materials for glass furnaces, such as Durox, the Corhart Refractories Company's cast mullite, and India sillimanite, much can be said of their resistance to glass. In several of the factories in California, Durox is very much in favor, and in the East the Corhart material has shown such merit that several complete installations have been made. Materials of this character can not be classified with what we have been accustomed to know as tank blocks.

The physical structure is entirely different, due not only to materials, but to the method of manufacture. I am very glad to see the interest and willingness of glass manufacturers to disregard the initial cost of this super-material. The greater interest shown now, the sooner we can adjust ourselves to meet the requirements of the future. There is sure to be a period when the clay block producer cannot carry stock except on order, as it is obvious that the many installations of these new materials will cause some delay in placing orders far in advance of requirements and manufacturers of the old type of block will have to be conservative in building up stocks.

In the near future I expect to see many changes in furnace construction. One will be the elimination of the present type of bridge wall or at least the position it has occupied in the past, and complete insulation of the side walls, regardless of what the side walls are composed of. I expect glass tanks built, in which ports will be at least 10 feet from where the batch is introduced (this applies to furnaces of 60 tons or over), and I expect to see all cullet reduced to the size of barley or grains of wheat and continuous automatic feeding of batch either by a worm feed or gravity.

One or the other of these features is in use individually some place and I see many reasons why they should all be combined in every furnace for the common good of all.

You do not now conform to old methods of making glassware and there is no reason why you should conform to old furnace construction or practice. I am leaving the subject of clay and glass from my viewpoint for your consideration and further discussion if there is anything of interest in it.

A Great Achievement—The Making of a Giant Disc

A new method of electrically annealing in the mold a 70-inch glass disk is winning world-wide distinction for the glass men of the Bureau of Standards at Washington

Doubtless the twenty-first of January, 1928, will always remain a red-letter day in the memory of A. N. Finn, chief of the glass section of the Bureau, for the uncovering of the furnace containing the disk of optical glass described below ended the long-continued strain begun with the development of a new and revolutionary process for casting and annealing such disks, and also involved him that day in a triumphant climax to his nine months of suspense during the cooling of the glass in the mold, the successful outcome of the important experiment having by no means been assured in advance.

A. N. FINN.
Chief of the Glass Section, Bureau of Standards

The great new disk, 11 inches thick, will be used as a concave mirror for the new reflecting telescope of the Perkins Observatory at Ohio Wesleyan University, Delaware, Ohio.

The money with which to establish this observatory was left to the University by Professor Hiram Mills Perkins of Ohio Wesleyan. It was his desire to establish an observatory of the first rank at the University and that the entire equipment be of American manufacture. It is significant that Professor Perkins had no desire for the observatory to bear his name. Nevertheless, after his death in 1924, his name was given to the new observatory, work on which had already been in progress for two years.

There was only one real obstacle to delay ultimate achievement—large disks of optical glass of the size required had never been made in this country and only twice abroad. Those that have been successfully completed are said to be imperfect, and although imperfections in the glass are not so important in a reflecting telescope as in a refractor, nevertheless it is always desirable to have glass as nearly perfect as possible.

The mounting of the great telescope was constructed by the famous American telescope makers, Warner and Swasey of Cleveland, Ohio, and with a mirror temporarily obtained from Harvard University, the observatory's program of research was started. Several American glass manufacturers were asked to submit estimates on a disk of the required size, but more were willing to guarantee when the work would be completed. Finally the director of the observatory, Dr. Clifford C. Crump, called upon the Department of Commerce for assistance. Although the Bureau of Standards of that Department has been making optical glass since 1914, most of which has been used by the American Navy in the construction of various optical instruments which are at least as essential as guns and armor plate to its high efficiency, no task approaching the magnitude of the present one had ever been attempted.

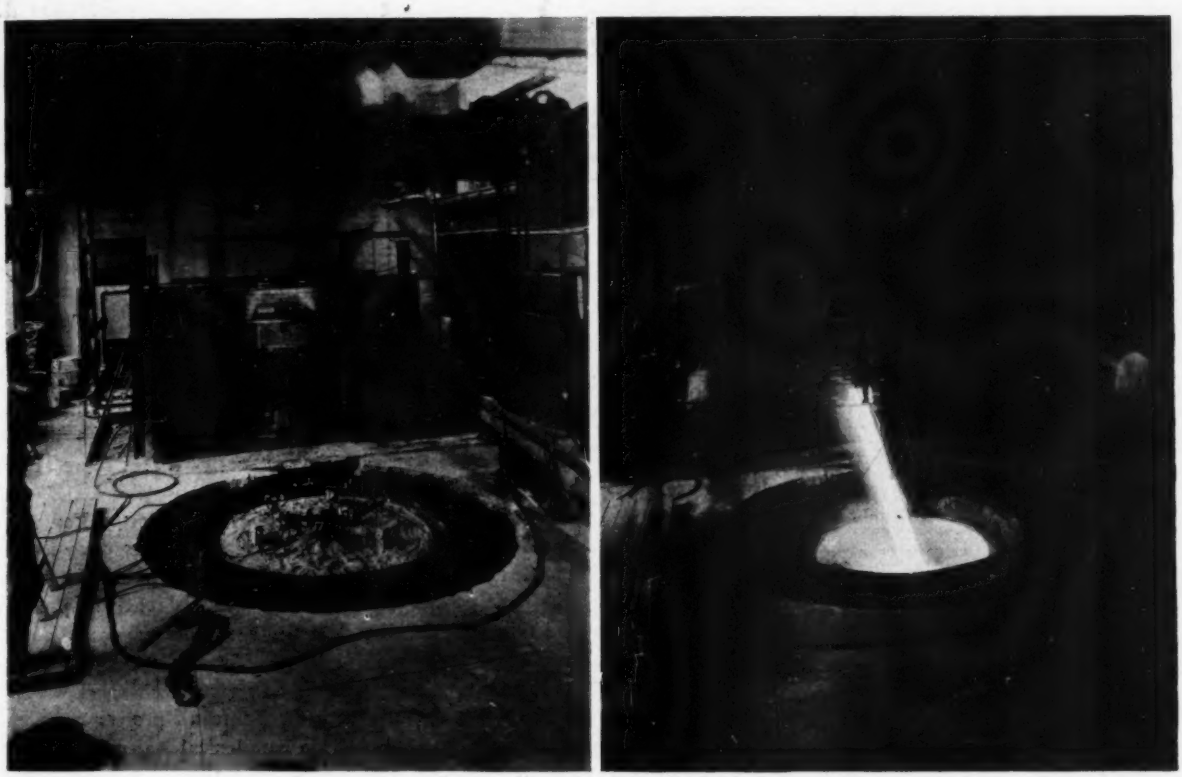
After four unsuccessful attempts to obtain a disk of the size required, a unique method was developed by Mr. Finn. One thousand pounds of cullet and 4,600 pounds of sand and chemicals were melted in a single large pot in a gas-fired furnace. The molten glass was stirred by hand for six hours and at the proper time on May 7, 1927, the pot was tapped. The molten glass was flowed into a mold of the required size which was specially designed for this purpose. This mold was at the same time a carefully insulated annealing furnace, provided with electrical heating elements by means of which the temperature could be adjusted and controlled to within a degree.

The percentage composition of the ingredients used was as follows:

	Per Cent		Per Cent
Sand	49.90	Barium carbonate	1.86
Boric acid	4.40	Saltpeter	6.57
Borax	17.55	Zinc oxide	1.86
Soda ash	5.69	Arsenic	.30
Potash	11.97		

The temperature of the glass when poured was about 2400 deg. F. For one week the temperature was slowly lowered until it reached 1112 deg. F. The glass was held at this point for about four days to allow the temperature of the glass and furnace to become uniform throughout. At 1112 deg. F. this particular kind of glass (borosilicate crown) is quite rigid and yet sufficiently viscous to yield to cooling stresses without danger of cracking.

Beginning on May 18 the glass was allowed to cool slowly at an average rate of 4 1-2 deg. F. per day till 860 deg. F. was reached. It was then annealed at this temperature for six weeks,



MELTING FURNACE AND MOLD, SHOWING PART OF THE ELECTRICAL EQUIPMENT FOR CONTROLLING MOLD TEMPERATURE DURING THE COOLING PERIOD AND, ON THE RIGHT, THE POURING OPERATION.

during which time no variation greater than 2 deg. F. was permitted. Final cooling was started on August 30 and room temperature was attained on January 16. The cover was finally removed on the morning of January 21 and the job was done.

During all these months there was no assurance as to what would be found in the annealing furnace when the final "unveiling" took place, because the slightest bit of foreign matter in the glass might start radial cracks which would split the glass into fragments. Too sudden changes in temperature would be equally serious. Doubtless Mr. Finn and his assistants have spent many sleepless nights during the past eight months, but they can now take pride in the fact that the Bureau has accomplished a unique and entirely successful piece of research work.

STIRRING THE GLASS

Dr. George K. Burgess, Director of the Bureau, points out that the experience gained for the scientific staff will be of inestimable advantage to the Bureau and to any American glass makers who may wish to profit by the Bureau's results, because, of course, all the information obtained is ultimately available to the American public.

The next step toward the completion of this reflector is to drill a hole at its optical axis. Although the majority of opticians would refuse to grind a hole in a piece of glass as large as this except at the owner's risk on account of the possibility of breaking it, the experts at the Bureau of Standards feel so confident that this can be done without any danger that they will do it at their own risk.

After this the disk will be sent to an optician to be ground, polished and "figured" on one surface till it becomes parabolic. Such a surface has the property of reflecting parallel rays of light to a focus. It is the curve used in automobile headlight reflectors, only in the case of a telescope mirror the curve is so slight that it is hardly noticeable.

With the completion of this disk, Professor Perkins' dream of an all-American telescope will soon be realized. That important contributions to our store of astronomical knowledge will ultimately result, seems certain. The successful consummation of this work, according to the Department of Commerce, has resulted from the cooperative efforts of several men within and outside the Bureau, particular credit being due J. Walter Drake, former Assistant Secretary of Commerce, Dr. S. W. Stratton, President, Massachusetts Institute of Technology and formerly head of the Bureau, Prof. C. C. Crump of Ohio Wesleyan University, and P. H. Bates, Dr. A. Q. Tool, and A. N. Finn of the Bureau of Standards.

TECHNICAL BULLETIN, No. 17. American Refractories Institute, Pittsburgh, Pa., November, 1927. An elementary account of the P. C. E. or the softening of refractories by heat.

THE PROBLEM OF TRADE ASSOCIATION LAW, by David L. Podel and Benjamin S. Kirsh, formerly associated in the prosecution of the glass, pottery and other cases arising under the Sherman anti-trust law. Reprint from St. John's Law Review, January, 1928, issue. Copies may be had gratis from the authors at 111 Broadway, New York.

Glass Industry

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The Fourcault Process

In order to study a manufacturing process to the best advantage it is advisable, if possible, to see it in operation where it has been originally invented. For it is likely that the man who has developed a process of manufacture is ahead of those who adopt it and who come after him. Belgium, then, is the best place to study the Fourcault process. If it is possible to come in contact with those closely associated with the invention, and its subsequent development, the opportunity is there to fully realize its importance.

No one who has seen the Fourcault sheet glass process in operation in Belgium can fail to grasp its meaning, to wit, that it is in every respect the equal of the Libbey-Owens process, and that these two processes are certain, in time, to replace the cylinder process, as has been evident to all who for years have seen that the hand process is a thing of the past.

It is not revealing any secrets to say that the Fourcault process outside of Belgium has not been the success it was hoped to be, and which it deserves. In several countries there are large factories that have adopted the process, and that now lie idle. Yet the Fourcault process is a success, if properly handled, as the owners of Belgian Fourcault plants are willing to show to anyone interested.

The great difficulty with the Fourcault process is its extraordinary simplicity. This paradoxical statement may be understood when it is considered that only a process that looks extremely simple would be attempted to be operated by men having no previous experience with this particular method. The fact that one is an experienced engineer, a good glass maker, a clever chemist, and a whole lot besides, is yet no guarantee that one can successfully operate a process so simple and yet so delicate. The temptation is there to go to it, without having had the training and experience absolutely necessary for success.

Only those can hope to fully succeed in the operation of a Fourcault plant who have taken the time to learn and who have been properly trained by *men who know* how to deal with the many and great difficulties of this process. To make modifications in the handling, and to take liberties with the approved designs, without first thoroughly knowing how to run an installation is another temptation strictly to be avoided.

The advantages of the Libbey-Owens and the Fourcault processes over the cylinder process are obvious enough, and undoubtedly a number of plants now operating the cylinder process will in time change over to the sheet process, whichever may be preferred. Those considering the adoption of the Fourcault process may well contemplate the melancholy sight of the graveyard of Fourcault plants, one in England, where thousands of pounds sterling lie buried till no one knows when, one in Holland, not to speak of those in our own country.

Whatever defects the mechanical equipment of the Fourcault plant of earlier days may have had, at present it is as nearly perfect as any piece of machinery can be. The difficulties of this process are primarily due to the nature of glass. The Fourcault glass maker is between the devil and

the deep blue sea. If glass is produced high in alkali, it may be workable but it will not resist weathering. If lime is increased weathering will be prevented, but the rate of devitrification will be so rapid as to make the working of such glass difficult. The problem is to select a batch composition that will produce glass having the proper viscosity at working temperature, that will not devitrify, nor will fall a prey to atmospheric influences. In the final analysis, control of a Fourcault plant is largely a matter of temperature control and glass composition.

Research work has shown that window glass having about ten per cent lime shows little tendency towards devitrification. Such a glass, however, would contain too much soda to be resistant to weathering, or too much silica to be workable. If a few per cent of the soda is replaced by magnesia, the working properties of the glass are thereby improved, and the resistance towards weathering greatly increased. Alumina, when used in small quantities, also decreases the tendency to devitrification, and increases the working range. It is likely that the solution of the problem to produce good Fourcault glass will be found to lie in finding the proper combination of soda, lime, magnesia and alumina, with reference to silica.

However, as stated before, a purely scientific solution cannot be hoped for. It must be found in a combination of engineering skill, furnace management, temperature supervision and chemical control, guided by managerial ability of the highest order. This can only be obtained after much experience or after careful training by those who already possess experience.

Correspondence

A Criticism

To the Editor of THE GLASS INDUSTRY:

A second reading of the article on furnace construction in your January number does not greatly enhance my opinion of it. I will not take time to analyze the author's figures—especially as he does not give enough data to allow much of an analysis—but will merely indicate some of the points in the article which are questionable.

None of us really has very extensive knowledge of the fundamentals which should underlie glass furnace construction and design. The average glass tank is built the way it is because a succession of glass tanks were built before it in the same place, the same way. Most of the radical changes made in glass tank construction have not resulted from increased knowledge of furnace fundamentals but rather from the necessity of changing the tank design to conform with changing methods of forming or shaping the glass. We realize that few, if any, glass tanks are really efficient from a thermal standpoint, but no one wants to be the dog on which a radical change in tank design is tried out; instead, changes must, of necessity, be made slowly and carefully because glass tank constructions or changes in design are extremely expensive operations. The frequently advanced freak tank designs may at times offer some features of merit, but until more is definitely known about furnace fundamentals no practical glasshouse engineer can be expected to take the chance of trying them out.

Within reasonable limits, as the great majority of glass tanks are at present constructed, the relative advantages of high and low crowns is a question which has never been settled. It is true that the majority of steel engineers, and to a lesser extent, glass engineers, favor the low crown, but the fact that there is so much argument as to which is the best is in itself good evidence that the difference, if any, between the two types of crown cannot be very great. This writer's claim that lowering the crown always lessens fuel consumption does not agree with my experience; for example, I have recently had contact with a glass tank on which the crown was dropped about ten inches—a decrease of about 15 per cent in combustion space; this tank was of the average type of construction and crown height, was more closely checked than is the average glass tank with respect to fuel consumption, temperatures, waste and raw gas compositions, pull, etc.; the drop in the crown height had no apparent effect on these or any other factor of furnace operation. There is no doubt but that tanks have been built with abnormally high crowns so that decreased thermal efficiency was to be expected if only because of increased radiating area; but such tanks have been and are the exception. The type of tank illustrated by the writer of the article in the January issue is, of course, an extreme case and is no more representative of glass tanks in general than the elephant with his long snout and large body is representative of the mammalia.

A combustion temperature of only 2730°F. seems very low with natural gas even with 25 per cent air excess if any normal preheat of the air is at all obtained. The writer of the article assumes that the motion of gases in a furnace is determined almost entirely by differences in density. Using the figures he gives for the density of gases, the difference between the density of the products of combustion at the assumed combustion temperature and at the furnace temperature is only a little more than 10 per cent; while such a difference undoubtedly has some effect, it would appear that the influence of this density difference would not be as great as that of the momentum of the incoming streams of fuel or of the rapid expansion incident to the combustion of the gas.

Much stress is put in this article on the effect of the influx of cold air into the furnace. There is no doubt that this factor can be and is of influence in the heat economy of a furnace, and that too little attention is paid to it; but experience shows that in few if any glass furnaces can the influx of cold air effect a heat loss anything like that assumed in this article.

Whether or not air will be drawn into a furnace depends on the relation between the pressure of that zone of the furnace contiguous to the walls and the atmospheric pressure. If this furnace pressure is greater than atmospheric no air can be drawn in, while if the furnace pressure is less than atmospheric, the opposite is the case. The pressure will not, of course, be uniform throughout the furnace or at all points at the furnace wall; for example, the pressure in the refiner is usually less than that in the melter.

Ordinarily no attention is paid to furnace pressure except as this affects the heat distribution in the tank and when a long stingout causes trouble in hand working. The pressure on glass tanks will very often be changed from "positive" to "negative" or vice versa through changes in stack draft without appreciably affecting melter temperatures or fuel consumption. While many furnaces are normally operated under negative pressure the greater part of their lives, the majority are operated under a positive pressure most of the time; whether a furnace pressure is negative or positive and the degree of positive pressure is roughly indicated by the presence or absence of a stingout and the length of the stingout; most glassmakers feel that combustion conditions in the furnace are best when a slight stingout shows at the working openings.

The presence of stingouts through working or other openings in the furnace naturally precludes the possibility of any cold air being drawn in through these openings except during the moment of reversal and the amount of cold air drawn in at that time cannot be large unless the tank man falls asleep halfway through the operation. A furnace may have a slight positive pressure in the melter and a negative pressure in the refiner resulting from the greater cooling at this point or from some other cause; that this is often the case is indicated by the fact that analyses of the refiner atmosphere at times shows an abnormally high oxygen content.

It is difficult to see just what the author means by his repeated mention of heat loss through "the absorption of heat by the chilled gases of combustion" in the furnace. The waste gases cannot leave the furnace at a temperature lower than that of the furnace and the nearer they approach the furnace temperature the more efficient is the heating. So long as the available heat of the flame is transferred to the furnace and its contents, it does

not matter much whether this transfer is direct or through the dormant waste gases as an intermediary. The absorbing power of the transparent waste gases is so low, that it does not seem as though they could effect much heat absorption from the flame. While it is not strictly correct to consider that heat lost through the stingouts as "loss by radiation" as is usually done, the actual practical heat loss through this agency is small, for not only is the volume of hot gases lost through stingouts small in comparison to that passing up the stack, but also most of the heat available to the furnace has been abstracted before this portion of the waste gas forms the stingout.

There are a number of other points in the article to which objection might be raised but the above will probably suffice. It seems evident from this article, that the writer has had experience only with a few window glass or other flat glass tanks of a rather extreme type and has assumed that all other glass tanks resemble these few. The suggestion to build the melter very wide and of shallow depth is not at all new and I have actually seen such a tank—although not as extreme a case as that proposed in this article—in operation; the only thing that could be said in its favor was that glass was actually made in it.

Columbus, Ohio.
January 30, 1928.

D. J. MCSWINEY,
Consultant on Glass Manufacture.

Patent Pools and the Anti-Trust Laws

WHILE SOME READERS may question the possibility of successfully applying to the glass industry the principle of interchanging patent rights, as has been done in other fields, all concerned with patent questions will be interested in the following abstracts from an article published under the above caption, in the *American Bar Association Journal*, of August, 1927. Reprints of the complete article may be obtained by request to the authors, David L. Podell and Benjamin S. Kirsh, members of the New York Bar, 111 Broadway, New York, both of whom were formerly Special Assistants to the United States Attorney in New York in the prosecution of Sherman anti-trust act cases, including the window glass case.

THE policy of encouragement to inventors, embodied in the Constitution and the patent laws, becomes especially significant in this age of endless discovery. It would be difficult to find an industrial unit of the first magnitude which has not imbedded somewhere in its structure the product of inventive genius protected by a patent. The issuance of a large number of interrelated patents and their distribution among various independent owners in the same industry, have presented forcibly the necessity of patent co-operation. An inquiry into the legal status of co-operative interchange presents the problem of the extent to which the rights acquired under the patent laws run parallel to or conflict with the liabilities, both civil and criminal, arising from a violation of the anti-trust laws.

In the annual reports of the Attorneys General of the United States for the years 1924 and 1925, the application of the Sherman Law to the acquisition and pooling of patents is noted as one of the major problems of anti-trust enforcement.

The interchange of patent rights has assumed various forms of which we need merely mention the most usual: The respective patentees may retain title to their patents and simply exchange reciprocal licenses to use their patents; they may transfer their patents to a trustee and retain a varying measure of control over the distribution of licenses; they may transfer their patents to a new corporation to whose officers is granted the power to issue licenses upon the terms agreed upon prior to incorporation; they may grant reciprocal powers of attorney to a common agency, which is authorized to distribute the licenses in accordance with an agreed plan.

Industrial and Social Value of Patent Interchange

No discussion of the legal questions involved can be thoroughly understood without some knowledge of the value to business and society of the co-operative interchange of patent rights. From the experience of American industry, a mass of information lies available to the student of the subject. This is evident, by reference to the cross-licensing arrangements in the automobile[1] and aircraft[2] industries, and the recent resolution of the National Electrical Manufacturers' Association.[3]

One of the underlying reasons for the formation of an interchange of patent rights lies in the practical necessity to adjust infringement litigation where there is a claim of overlapping patents. No royalties, however great, would suffice to pay the tribute which protracted and costly patent litigation exacts. An inflated selling price of the commodity ensues. There is a shift, by incidence, of the price of litigation to consumer. It is, therefore, but prudent and economical business policy to compromise what otherwise would entail enormous expenditures and lead to a diminution of sales.

Fear of infringement suits, injunctions, and decrees for heavy damages, has dissuaded manufacturers from making expenditures to improve their plants and has resulted in enhancement of prices to secure them against the risk of operation under doubtful patents. Thus it has been said with reference to the cross-licensing agreement in the aircraft industry, that it is "a practical business arrangement to do away with litigation over patents *and permit the members to build planes rather than try lawsuits against each other.*"

Moreover, a practical consideration arising from our heavily burdened court calendars is, that the original trial of a patent suit is not generally reached, in many districts, before two years, and that before a final adjudication can be reached, some four to seven years may elapse, if both parties insist upon exhausting their remedies.

Even the payment of royalties under a cross-licensing agreement becomes, therefore, an economically sound business arrangement whereby, in effect, an insurance policy is taken out as security from attack, at a cost known in advance.

From a purely economic viewpoint, a mere dedication of reciprocal non-exclusive licenses can be subjected to no reasonable criticism. The industry at large, which is judged by the output of its entire production, gains the direct benefits. There is an increased good will arising from greater confidence in the minds of consumers. Therefore, every product can embody the latest and most approved engineering ideas, and still retain for each manufacturer individuality of design, which is his distinguishing selling feature. The raising of standards follows as a natural consequence.

Another important advantage of cross-licensing is in its value to each individual party to the agreement, in securing for himself the results of a large volume of development-research and the accumulated practical experience embodied in the patents of his cross-licensees. A company putting in five patents may acquire the use of 125 in return, an advantage far outweighing the exploitation of its own inventions.

It has been demonstrated by the recorded experience in the automobile industry, that such agreements give an impetus to further invention.

A patent, owned or controlled by one member of an industry may be useless in itself, yet extremely valuable when combined in use with other patents owned by his competitors. By breaking up what has been aptly termed the "congestion of patents," every patent owner is free to improve his product. Without the privilege of making use of the numerous improvement patents, the patentee finds himself in the position of the owner of a key plot who must pay a stipend to assemble contiguous plottage.

Again, the psychological factor in industry is extremely improved when its members can feel that they are united with a single purpose of bettering their product through the common utilization of technical knowledge.

The knowledge of manufacturing licensees under patent pool agreements that they have protected themselves against infringement suits permits each manufacturer to devote his energies to the development of a better and cheaper product, make further investments for improvement of his plant, and promote sales.

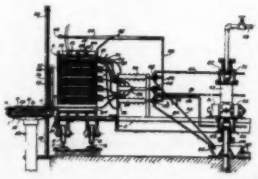
[1] Cross-licensing agreements of National Automobile Chamber of Commerce. [2] Cross-license agreements of Manufacturers' Aircraft Association. [3] Resolution of National Electrical Manufacturers' Association, *N. Y. Times*, March 19, 1927.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

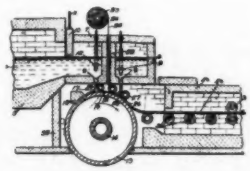
Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

APPARATUS FOR MAKING COMPOSITE GLASS. U. S. 1,657,227. Jan. 24, 1928. William Owen, Pittsburgh, Pa., assignor to the Pittsburgh Plate Glass Co. Filed 3/10/27. Heretofore it has been the practice to assemble the set of sheets to be joined in a rubber bag or container, which is then placed in a tank and exposed to hydraulic pressure, the interior of the bag being open to the atmosphere, and the liquid which applies the pressure being heated to soften the gelatin. The object of the present apparatus is to provide a more convenient means for carrying out this procedure. This is accomplished by substituting for the rubber bags, pairs of rubber diaphragms between which the sets of plates to be joined are placed, and by providing for a multiple pressing and heating operation. In carrying out the operation, the sheets of glass and celluloid to be joined together are brought to a position adjacent the turntable 1 by means of the trucks. The glass sheets are each coated on one side with a thin film of gelatin, which has dried thereon, but which is readily softened by the application of heat. The sheets are assembled in sets of three with the sheet of celluloid between the two sheets of glass, and the sheets as thus assembled are ready for the application of heat and pressure in the pressing apparatus, to which the invention is particularly directed.



METHOD OF DECORATING GLASSWARE AND ARTICLE PRODUCED THEREBY. U. S. 1,656,260. Jan. 17, 1928. E. A. Zeh, Clifton, N. J. Filed 4/5/26. Affixing a colored label to a clear glass bottle, a method which consists in positioning a thin background forming coating of a metallic color on the glass surface, having the outline configuration desired of the completed label, subjecting the bottle with such coating to a firing treatment for a short period of time and at a temperature sufficiently high to fuse the background firing color gently to the face of the glass, positioning on the background thus formed a decalcomania of the desired label located accurately with relation to the outlines of the background and formed of a plurality of metallic colors contrasting with the color of the background and subjecting the same to a second firing treatment to fuse the decalcomania design to the background design.

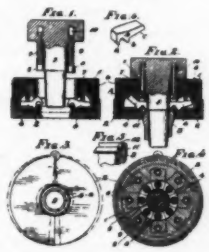
WIRE-GLASS MACHINE. U. S. 1,656,048. Jan. 10, 1928. Joseph P. Crowley, Toledo, O., assignor to the Libbey-Owens Sheet Glass Co. Filed 2/21/25. An apparatus for producing sheet glass wherein a plurality of streams of molten glass are flowed upon a rotatable drum to produce a divided sheet source, and includes means for feeding a wire fabric between the sheet source so that a sheet can be rolled from said molten glass and having wire fed therein to give a sheet of glass reinforced by a wire fabric.



A sheet is rolled from a quantity of molten glass after which a wire fabric is positioned thereon, and then a second sheet is rolled upon the first to produce an integral sheet having a reinforcing wire embedded therein.

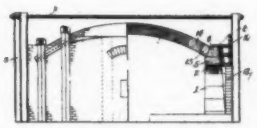
RECUPERATIVE FURNACE. Re. 16,826. Dec. 20, 1927. Charles M. Stein, Paris, France, assignor to Societe Ch. M. Stein & Cie. Filed 10/5/27. A vertical furnace of the class described, comprising a hearth, means for admitting and burning therein a combustible mixture of air and gas, means for exhausting the products of combustion therefrom, a recuperator through which the incoming air passes and through which the outgoing products of combustion pass for heating said air, and a smoke collector for the final exhausting of the products of combustion provided with means for regulating said exhaust.

MOLD HEAD FOR THE FORMATION OF A FISSURE IN THE MOUTH OF GLASS BOTTLES, OR PORCELAIN, ETC. U. S. 1,655,917. Jan. 10, 1928. Felipe Obiol, Buenos Aires, Argentina. Filed 2/10/26. An automatic attachment for forming the internal groove in the neck of a bottle by means of a series of specially formed sectors operatively associated with a central plunger to fold into position to form the groove during the initial compression of the glass and to effectively release themselves from closed position to permit uninterrupted withdrawal of the bottle head. Figure 1 is a vertical sectional view of the bottle neck molding device equipped with the internal groove form units shown in open position; Figure 2 is similar view of the parts in closed position and a bottle mold in place; Figure 3 is a bottom plan view of the mold head; Figure 4 is a transverse sectional view taken on lines A—A of Figure 2; Figure 5 is a sectional view of a bottle neck and cap; and Figure 6 is a perspective view of one of the sectors for forming the internal groove in the bottle neck.



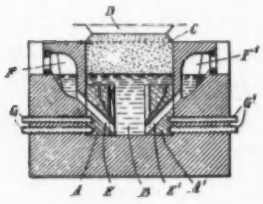
MACHINE FOR MAKING GLASS CONTAINERS. U. S. 1,657,921. Jan. 31, 1928. Warren G. Glaspey, New York, N. Y., assignor to Spring Stopper Co. Filed 6/2/27. Relates more particularly to glass containers provided with internally threaded mouth portions, adapted to receive threaded stoppers. Includes a sleeve in conjunction with each mould adapted to embrace the plunger and provided with a male thread on its lower end, said sleeve adapted to fit in the neck of the mould; a swingable support for the sleeve, adapted for swinging movement to move the sleeve from a position over the mould to a position to one side of the mould and vice versa.

FURNACE CONSTRUCTION. U. S. 1,655,680. Jan. 10, 1928. David H. Goodwillie, Toledo, O., assignor to Edward Ford Plate Glass Co. Filed 11/8/26. The object of this invention is to provide a furnace structure which will permit a removal of the pillars and arches without disturbing the roof or crown structure, thereby materially reducing the time, labor, material and expense incident thereto over what has heretofore been required. In practice, it is found that it is necessary to replace the pillars and arches of glass melting furnaces about once every nine or ten months, and that the expense of removing and rebuilding the crown or roof alone runs in the neighborhood of $1200. The inventor's claims include in a furnace structure, a roof, a side arch portion meeting the edge of the roof, buckstays at the outer side of the arch portion and disposed at the ends of an arch, a thrust bracket carried by each buckstay, and means forming an integral portion of the roof structure at the edges thereof and concentrating the roof load at points opposite said brackets and distributing the load thereto whereby the roof is supported independently of the side arch portion.



DECORATED GLASS AND METHOD OF MAKING SAME. U. S. 1,658,015. Jan. 31, 1928. Arthur Howe Carpenter, La Grange, and Philip C. Huntley, Riverside, Ill. Assignor to the Vitrolite Co. Filed 12/10/25. The method of producing a surface finish on a glass member, which consists in placing on the same, while in a hot, plastic condition, a woven glass cloth having designs therein formed by colored glass threads, then pressing the cloth against said member and applying heat.

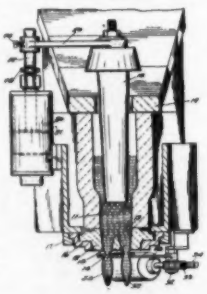
ELECTRIC FURNACE FOR MELTING OR PRODUCING GLASS, WATER-GLASS, CEMENT, OR OTHER SUBSTANCES. U. S. 1,656,510. Jan. 17, 1928. Cornelius Erik Cornelius, Stockholm, Sweden. Filed 2/26/26. The inventor states that previous attempts to produce glass electrothermically have always given negative results on account of the glass at the melting being to a greater or lesser extent fouled by electrodes and such like. The invention is based partly upon observation of the fact that iron objects submerged into molten glass do not undergo any change, and partly upon the fact that glass in a molten condition is a conductor of electric current. The melting furnace is constructed on the principle of resistance, and as resistance molten glass is used, and as electrodes is used iron free from carbon or iron with a small percentage of carbon or some other suitable metal or metal alloy with a sufficiently high melting point. The metal electrodes are so adapted that they are able to accumulate or store within themselves a large amount of heat so as to be able to keep the molten mass at the desired temperature, if there is any tendency to variation in the same. The electrodes must be provided with a pyrometer which indicates their temperature. By means of the pyrometer it is also possible with a simple device to regulate the supply of current to the furnace.



SHEET-GLASS APPARATUS. U. S. 1,656,102. Jan. 10, 1928. John L. Drake, Toledo, O., assignor to the Libbey-Owens Sheet Glass Co. Filed 7/19/26. In sheet glass apparatus a receptacle containing a mass of molten glass, a pair of rolls between which the glass passes in sheet form, one side of the sheet being relatively hotter than the other side thereof, the hotter side of said sheet having greater contact with its respective roll than the other side with its respective roll, the wall of the roll contacting with the hotter side of said sheet being relatively thinner than the wall of the other roll.

APPARATUS FOR ROLLING GLASS. U. S. 1,657,214. Jan. 24, 1928. Karl G. Kutchka, Wilkinsburg, Pa., assignor to Pittsburgh Plate Glass Co. Filed 6/9/26. The combination in glass rolling apparatus having a pair of internally water cooled rolls, of supplemental cooling means for one of the rolls, comprising a header extending longitudinally thereof along one side and provided with outlet means along one side directed against the surface of the roll and means for supplying a gaseous cooling fluid to said header under pressure.

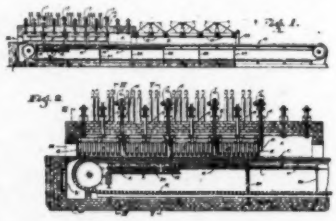
GLASS FEEDER. U. S. 1,653,479. Dec. 20, 1927. Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co. Filed 5/12/23. The inventor claims a practical glass feeder adapted to simultaneously deliver a plurality of mold charges or gobs of glass of comparatively small size, including means for segregating individual masses or charges of glass from a supply body, comprising a plurality of cutters operating at separate points, means for actuating the cutters periodically in synchronism, means to effect a relative adjustment of the cutters to cause them to operate either simultaneously or one in advance of the other.



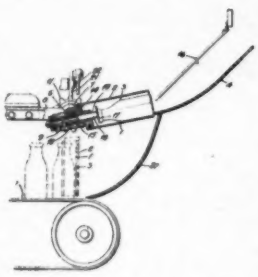
APPARATUS FOR MAKING PLATE GLASS. Re. 16,856. Jan. 17, 1928. Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Co. Filed 2/1/27. Relates to apparatus for producing a continuous sheet or ribbon continuously from a body of molten glass. Improved means for accomplishing the function as above set forth and for producing glass of superior quality, which is perfectly flat and relatively smooth so that it requires a minimum amount of grinding preliminary to polishing in the production of finished plate glass.

APPARATUS FOR FEEDING GLASS INTO MOLDS. U. S. 1,655,190. Jan. 3, 1928. August E. Liepold, St. Louis, Mo., assignor by mesne assignments to Ball Brothers Co. Filed 3/23/25. One object is the method of feeding gobs of molten glass to the mold of the forming machine in which the severed end of the glass is drawn up and reheated thereby eliminating chill marks in the finished article.

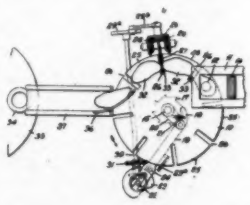
GLASS-ANNEALING LEHR. U. S. 1,657,797. Jan. 31, 1928. Kenneth M. Henry and Payson D. Burtt, San Francisco, Cal., assignors to Illinois Pacific Glass Corp. Filed 12/4/24. A glass-annealing lehr, comprising a furnace structure having a horizontally extending tunnel, an endless conveyor therein for moving glass articles through the tunnel, the space above the upper run of the conveyor being divided into a heating section and a cooling section, said heating section being provided with means to subdivide it into a plurality of zones, electric heating elements on the sides and roofs of each of said zones, and a temperature responsive device in each zone electrically connected with the heating elements therein for automatically maintaining a predetermined temperature therein, and partition means between the upper and lower runs of the conveyor.



APPARATUS FOR HANDLING GLASSWARE. U. S. 1,657,680. Jan. 31, 1928. Edward H. Lorenz, West Hartford, Conn., assignor to Hartford-Empire Co. Filed 1/29/26. A bottle, upon reaching the lower end of the chute 4, first frictionally engages a hinged plate 16 which retards its movement. The bottle upon entering the holder engages a shock absorbing stop 17 comprising a plunger 18 which is slidably mounted in the rock shaft 9 and which is yieldably urged outwardly by a spring 19. As the bottle enters the holder, the sleeve 6 is rocked about its axis by the sprocket wheel 11. This movement swings the holder to a vertical position and deposits the bottle in a neck-up position on the conveyor 5. During this movement, the bottom of the holder moves adjacent to a stationary arcuate plate 20 which prevents the bottle from falling out of the holder during its transfer and reversion.



METHOD AND APPARATUS FOR FEEDING MOLTEN GLASS. U. S. 1,657,640. Jan. 31, 1928. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Co. Filed 8/29/25. Method and apparatus for forming mold charges by depositing a continuous supply of molten glass on a receiver, and severing the deposited glass, while on the receiver, into mold charges of the desired size. This object is accomplished by discharging a continuous stream of glass from the outlet of a container on a movable receiver having a motion adapted to form the deposit of glass into a series of charges having periodically varying cross sectional areas, and severing the charges at the smaller sections to form mold charges.



BOTTLE MACHINE. U. S. 1,658,735. Feb. 7, 1928. Frank O'Neill. Toledo, O. Filed 11/11/24. A glassware forming machine comprising a rotary table, an annular series of radially disposed bearings carried by the table, a drum in each bearing, a mold carried by each drum, each drum provided with a disk, pins carried by the disk, driving means for the table providing stations of rest, and a fixed segment with which said pins may coact, said segment extending from short of one station of rest past a second station of rest and just beyond a third station of rest.

Glass Factory Equipment and Supplies

Most of the information printed in this department comes direct from the manufacturers of the products described.

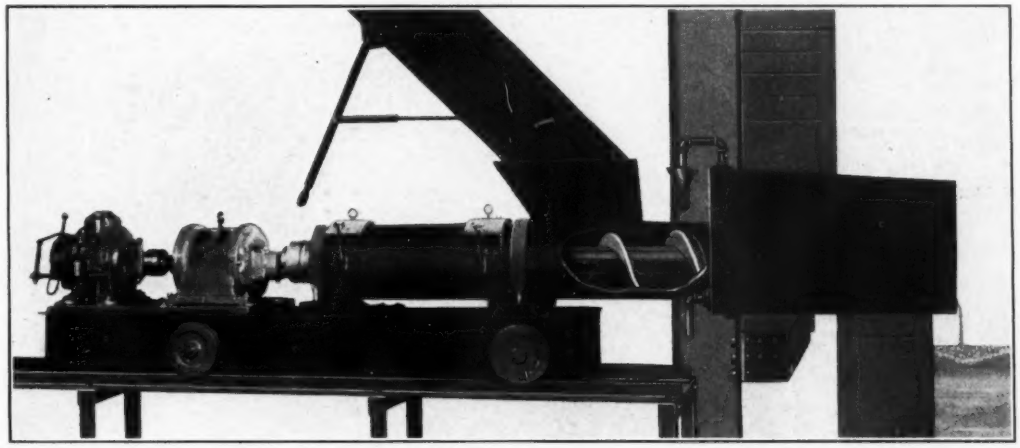
A New Labor Saving Device

The new continuous batch charger recently brought out by H. L. Dixon Company, Pittsburgh, Pa., is intended to abolish what continues to be, in many plants, the only remaining manual operation occurring in the process of glassmaking. Mechanical methods for feeding furnaces have been worked out with more or less success and after expensive experimentation by a few individual factories. The device here described has been made available to all of the trade.

The principle on which the machine operates is plainly indicated in the illustration, several novel features being involved. The steel carriage on which the spiral conveyor, motor and speed reducer are mounted may easily be moved back from the furnace and batch bin chute whenever it is desirable to do so. The whole machine is substantially constructed, Dixon's Vanad iron being freely utilized in its manufacture. The furnace man controls by mechanical means the rate of feeding the batch into the furnace.

There are decided advantages in the use of a mechanical method of charging the batch materials. The rate of feeding is adjusted closely to the rate of consumption of molten glass by the machines at the other end of the tank. The batch materials are introduced into the tank in a steady stream, not suddenly or violently cast in bulk, creating less disturbances in the body of molten glass and being conducive to more rapid and uniform melting.

The hot, dirty job of shoveling or dumping the dusty materials is done away with and other economies effected, including elimination from the finished glass of defects due to irregular feeding of the batch.



NEW DIXON CONTINUOUS GLASS BATCH CHARGING MACHINE

Industrial Publications

Automatic Temperature Control as applied to industrial furnaces. An eight-page discussion of the subject, issued by Wilson-Maeulen Company, 385 Concord Avenue, New York. An explanation of manual temperature regulation leads up to a discussion of automatic temperature regulation or control. The rapidly growing use of control apparatus for lehrs, enameling, japanning and clay drying ovens is referred to.

Flush-Type Cases for Chart Recorders. The Brown Instrument Company, Philadelphia, Pa., have issued a circular relating to their new Brown continuous strip chart instruments in cases of the flush type which permit the recording mechanism to be drawn out of the case at the front for easy inspection, after which it can be pushed back into place, a locking device holding it firmly in position.

The Artistic Lighting Equipment Association, 420 Lexington Avenue, New York, has issued an interesting booklet on outdoor lighting equipment and lanterns, showing various phases and applications of this type of lighting. It gives the origin and development of the lantern. It is profusely illustrated and indicates the artistic and decorative possibilities, as well as utilitarian advantages and protective features of exterior lighting.

Small Multi-Stage Centrifugal Air Compressors. General Electric Company, Schenectady, N. Y. A four-page folder showing applications, including glass blowing and other glass factory purposes, construction details, operating characteristics and ratings.

Directory for the British Glass Industry, Second Edition. Compiled by G. S. Duncan, edited by Professor W. E. S. Turner. Published by the Society of Glass Technology, Darnall Road, Sheffield, England. Price, bound in cloth, to members of the society and advertisers, 6 shillings; to non-members, 7 shillings, sixpence. Postage sixpence extra. Contains alphabetical and classified lists of glass manufacturers, benders, bevelers, cutters, decorators, etc., wholesale dealers in glassware, firms supplying glass works equipment and raw materials, industrial associations, city companies, trade unions and their officials, educational institutions and scientific societies, and a list of recent books and periodicals.

Amco Industrial Furnace Recuperator.—An eight-page pamphlet issued by the Amsler-Morton Company, Inc., Fulton Building, Pittsburgh, Pa., discussing recuperation versus regeneration for industrial furnaces and describing the Amco patented recuperator. This circular makes the statement that air is being preheated to 1640 degrees for the Owens revolving pot by the latest Amco four-pass recuperator with highly conductive selected materials. This is within 560 degrees of the furnace temperature. This unusual performance is only possible when the preheated air and waste gases move at maximum velocities within the conductive limits of the various materials employed in such a structure. Natural or forced movement of air through the recuperator can be used, selection being based upon field conditions.

The Glass World and What It Is Doing

News of the Industry

Triplex Safety Glass Companies Activities

The Triplex Safety Glass Company, Ltd., of England, has entered into a contract to furnish safety glass to the Austin Motor Company, Ltd., who build about one-third of the entire British production of motor cars. The contract will amount in value to from $2,500,000 to $3,750,000 per annum. One new factory has been bought and two additional factories will be erected at King's Norton to provide sufficient capacity to take care of the production of British cars equipped with Triplex. On the 1st of March this year the total authorized capital of the Company of £150,000 in £1 shares will have been issued, creating a permanent reserve account exceeding £185,000. No loans or charges will be outstanding at the end of the financial year ending June 30, 1928. Cash resources as a result of the issue of shares will be approximately £200,000, fully sufficient for the erection of the two new factories and provision of additional working capital.

Thin plate glass required for the production of Triplex is being provided by the installation of special grinding and polishing machinery at Pilkington Brothers, Ltd., with whom a contract has been made to furnish the glass required by the Austin Motor Company's contract.

The Triplex Safety Glass Company of North America recently entered into a contract with the Ford Motor Company for the use of Triplex in Ford windshields under which the Ford Company has the right to manufacture one-half of its requirements of Triplex without payment of royalty or profit, but the other half must be ordered from the American Triplex Company. This contract contains a provision that the Ford Company shall always keep the American Triplex Company informed as to the method of manufacture employed, and the British company's agreement with the latter company provides for a mutual exchange of information. Under their contract with the Safety Glass Company of North America, the British company receives royalty of 2 per cent on their turnover for 25 years and have had allotted to them all the second preferred stock entitled to 10 per cent of the profits available for dividend on the common stock of that company.

Triplex Safety Glass Company of North America has acquired in exchange for its founders shares, the exclusive license from the Triplex Safety Glass Company, Ltd., of England to manufacture and sell Triplex safety glass in North America.

Will Burn Silica Brick in Continuous Kiln

The Harbison-Walker Refractories Company, Pittsburgh, Pa., annual statement for the year ending December 31, 1927 shows a net income of $4,012,268 after charging off depreciation of plants and equipment, $550,000, mining and tram outfits, $102,005; depletion of clay, coal and ganister properties, $35,724. Dividends of $177,369 were paid on preferred stock and on common stock, including a 2 per cent extra, $2,776,438, leaving an addition to surplus of $1,058,461 and making the total surplus on December 31, 1927, $5,878,840. A report to the stockholders made by H. W. Croft, chairman, states that the construction of a continuous kiln at the East Chicago, Ind., plant for the burning of silica as distinguished from fire clay brick bids fair to be the outstanding development in the industry. Silica brick have never been burned in the United States in other than periodic kilns. This new process was undertaken only after the most careful personal investigation of the latest German practice by the directors. The kiln will be in operation approximately the first of July. Two of the company's old plants at Layton, and Farrandsville, Pa., have been dismantled and the cost of same charged off completely. A ten per cent increase in producing capacity was acquired with the purchase of the Vandalla plant of the Walsh Fire Clay Products Company, St. Louis, Mo. Large reserves of high grade fire clay were included.

Tariff Commission Tabulates Window Glass Costs

Senator Samuel M. Shortridge of California was recently requested by the Chamber of Commerce of Santa Ana to obtain information as to the status of the U. S. Tariff Commission's investigation into foreign and domestic production costs of window glass; in response, the senator sent a telegram, addressed to Secretary G. A. Raymer, of the Chamber at Santa Ana, and to W. L. Heater of the Standard American Glass Company, the full text of which is published in the *U. S. Daily* on February 7, as follows:

> "I beg to quote from a letter received from chairman of the United States Tariff Commission this morning in re Commission's investigations for purposes of section 315 concerning window glass:
>
> 'Since last communicating with you upon the subject the Commission has obtained the cost of producing window glass in practically all of the factories in the United States, including those on the Pacific Coast, and in addition the cost of producing the glass in Belgium has been obtained although the cost records have not yet reached the Washington office from the Commission's office in Brussels.
>
> 'The domestic cost data are being tabulated and analyzed from the individual cost schedules and as soon as the Belgian data are received they will be drawn off on similar sheets. In view of the large amount of information obtained by the Commission it will be several weeks before the hearing can be held.'"

Last Year's Foreign Glass Trade

With the compilation by the Bureau of Foreign and Domestic Commerce of the glass and glassware imports and exports for December, 1927, the totals for that year become available. Detailed figures for 1927 and comparisons with the corresponding figures for 1926 are tabulated in the Monthly Summary on page 74.

The import total for 1927 shows a loss in values of $3,841,514. The principal items in which reductions occurred are: Cylinder crown and sheet glass, $329,467; bent, ground, beveled, colored, painted and polished glass, $45,825; plate, $4,209,963; bottles, vials, jars, demijohns and carboys, $62,391; bulbs for electric lamps, $48,339; chimneys, globes, etc., and illuminating glassware, $56,759.

Increases over 1926 in imports are shown in these items: cut and decorated glassware, $813,132; table and kitchen utensils, $82,260; miscellaneous glassware, $125,128; there were small gains in chemical and scientific articles and an insignificant loss in bottles.

Exports as tabulated on page 74 show a total loss compared with 1916 of $390,533, made on shipments of: Window glass, $66,081; glass containers, $37,054; table glass, $222,068; cut or engraved glass, $29,194; chemical glassware, $11,582; electrical glassware, except lighting, $248,769. Following are items in which gains were made: Plate glass, unsilvered, $103,793; miscellaneous window and plate glass, $161,641; lamp chimneys and lantern globes, $2,256; lighting globes and shades, $12,528; miscellaneous glassware, $33,997.

New Company to Make Non-Shatterable Glass

A new company, the Pittsburgh Safety Glass Company has been incorporated with a capital of $1,000,000 to make laminated or non-shatterable glass which will be sold under the trade name Duplate. The owners of the new company are the Pittsburgh Plate Glass Company and the DuPont Viscoloid Company, manufacturers of pyroxylin plastics. B. P. Davis of the latter company is chairman of the board and H. S. Wherrett, vice-president of the Pittsburgh Plate Glass Company, is president of the new organization. Through the DuPont connection, the General Motors Corporation is interested. R. L. Clause of Pittsburgh Plate Glass Company, is vice-president and general manager; H. B. Higgins, general sales manager of the same company, is secretary, and W. Z. Reisinger of the DuPont

Company, treasurer. A. B. McClure of Ford City, Pa., will be superintendent.

It is said that a new DuPont product and the thin plate glass required for windshields, etc., comprising the finished "unbreakable" glass can be manufactured at a cost that will permit its use in low-priced automobiles.

Duplate is being made at present in a temporary plant at Creighton, Pa. It is said that a new plant will be erected within a very short time which will have a production capacity of several million square feet per year.

Pittsburgh Plate New Construction

The Pittsburgh Plate Glass Co.'s grinding and polishing plant at Works No. 4, Ford City, Pa., will be completely rebuilt and new grinding and polishing units installed involving an expenditure, it is said, of several million dollars. According to H. S. Wherrett, vice-president of the company, only a few skilled men will be needed from the outside. From eighteen months to two years will be required for completing the work, but it is planned to keep the plant in operation until a short time before the improvements are completed, necessitating but a short shut down. The tearing down of the old buildings is now going on and reconstruction will start shortly. Works No. 5 is also included in the plans for reconstruction. Plant No. 2 at Mount Vernon, O., which has been closed down since September, is being put into operation and Plant No. 1 at Creighton resumed operations early in February after a shutdown.

J. M. Belleville of the Pittsburgh Plate Glass Company recently visited the city of Richmond, Cal., and conferred with local business men in regard to a site for the company's proposed new manufacturing plant on the Pacific coast.

The Clarksburg plant of the company is being remodeled, according to local reports, to manufacture window glass by the sheet drawn process, instead of by the cylinder process as heretofore. It is reported that the cost of remodeling will amount to about $450,000.

Coming Fashions in Glassware

"The demand for more delicate colorings and more refined shapes in tableware and other glass is becoming more general," said an executive of a prominent glassware manufacturing concern recently. A growing preference for well-designed, high grade ware in appropriate colors of good quality and not needing decorations in order to be attractive, is noticeable. In the decorated line a general tendency is reported also in the demand for delicate shades and colors.

Uniformity of color throughout complete sets is the keynote for 1928. Blues and greens can be reproduced effectively, but in red, pink and rose color uniform results are difficult to obtain.

New Window Glass Manufacturers' Association

A new organization of window glass manufacturers was formed in New York on February 16 under the name of the Window Glass Manufacturers Association. The purpose of the new organization is to better conditions in the window glass field. Its activities will include the encouragement of research work and investigations, experiments in the window glass field, the collection and distribution among its members of information relating to the domestic and foreign markets and data on window glass production, market conditions, stock on hand; but no illegal activities are to be promoted. Attention will be given to developing new uses for the members' products and for the waste products incidental to production. W. L. Monro was elected president of the new association, Frank Bastin, vice-president, and Charles R. Stevenson, secretary and treasurer.

The new organization is affiliated with the National Glass Distributors Association. Its next meeting will be held at Hotel McAlpin, New York on March 21.

Fostoria Glass Activities

The Fostoria Glass Company, Moundsville, W. Va., have let the contracts mentioned in the February issue for a new furnace to H. L. Dixon Company, Pittsburgh, Pa., and for four lehrs to the Simplex Engineering Company, Washington, Pa. The lehrs will have woven wire conveyor belts and an additional belt has been ordered for an old lehr. The Fostoria Company is one of the few reported as enjoying good business. They are bringing out attractive new shapes and colors.

Feeder Patent Case May Be Compromised

A report from a reliable source is to the effect that a compromise between the conflicting interests now engaged in litigation in the Federal Court at St. Louis over feeder patents is being negotiated and in all probability will eventually be effected.

The taking of testimony from many witnesses was brought to a close on February 9. The decision in case no compromise is reached, will be rendered by the judge at his discretion.

German Suit Against Owens Firm in Judge's Hands

Briefs in the case of the Europaischer Verband der Flaschenfabriken against the Owens Bottle Company were to be filed by March 1 in accordance with Judge Westenhaver's instructions. The question as to whether international contracts made before the World War were abrogated or simply suspended is one of the important points raised in this trial. The taking of testimony in the Federal Court at Toledo occupied six days and a large number of lawyers were engaged on both sides. The trial is considered one of the most important ever conducted in Toledo.

Hazel-Atlas Glass Stock Rises

The Hazel-Atlas Glass Company in their annual report state that net profits of $2,365,214 were made during 1927. The surplus for the year is $3,565,929. The annual meeting was held February 28, 1928, at Wheeling, W. Va., too late to report in this issue. On the Wheeling Stock Exchange on February 18, Hazel-Atlas Glass stock sold at the high mark of $80. One supposed cause for the continued advance was a rumor that the Owens Bottle suit had been settled to the advantage of Hazel-Atlas, and it was also reported that one of their large competitors had sold out to new interests which would be expected to mark up the sales prices of several of their leading lines produced by the competing concern.

Standard Plate Glass Strike Settled

The Standard Plate Glass Company, Pittsburgh, Pa., and the striking employes who have been out since November, 1927, reached an agreement the latter part of February, the men to return to work on the basis of a reduction of 7½ per cent on wages of 40 cents and upward an hour and 5 per cent on wages below 40 cents an hour. This is half of the reduction in wages made by the company last Novembeer, the announcement of which caused the strike. About 500 workmen returned to work.

U. S. Silica Company Sells Plant to Ottawa Firm

The United States Silica Company, Chicago, Ill., announce the disposal of their sand production plant to the Ottawa Silica Company, Ottawa, Ill. In their announcement in the advertising pages of this issue, they bespeak the goodwill of their former customers in favor of the new owners of the plant and assure them of quality products and efficient service from the Ottawa Silica Company.

Slight Rise in Plate Glass Prices

During the week of February 12 several of the plate glass manufacturing concerns began quoting slightly higher prices than those prevailing recently.

Glass Pot Merger Reported

It is reported on good authority that a merger of glass pot and refractory manufacturers is being negotiated, about fifteen factories being involved.

Trade Activities

The Rolland Sheet Glass Company have resumed operations in their Fourcault plant at Clarksburg, W. Va.

The Diamond Glass Company, Royersford, Pa., is reported to have resumed operations in their No. 1 furnace.

The American Plate Glass Company, it is reported, will resume operation in the Durant City, Pa., plant about the middle of March.

It is reported that a glass tank at the **Wightman Bottle and Glass Manufacturing Company,** Parkers Landing, Pa., burst on February 7 and will have to be rebuilt.

The Hart Glass Manufacturing Company, Dunkirk, Ind., manufacturers of bottles, early in the year increased their capital stock from $500,000 to $1,500,000.

The Interstate Window Glass Company, Kane, Pa., has sold its factory at Smethport, Pa., which had been idle for about three years, to A. Cooper, Syracuse, N. Y.

The National Sash & Door Company, Independent, Kans., is reported to be completing an installation of four Fourcault machines and expect to begin operations in March.

The Seaboard Glass Corporation, 451 Communipaw avenue, Jersey City, N. J., has been incorporated with a capital stock of $125,000 to manufacture glass and glass products.

The Royal Glass Works Corporation, 70 Kent Avenue, Brooklyn, N. Y., has been incorporated with a capital of $500,000 by David Broadwin and will deal in window glass, etc.

Loriaux Glass Company, Fredonia, Kans., is reported to be in charge of G. E. Klock, who is secretary and treasurer of the company, as receiver. No interruption in operations is expected.

The Hill Clutch Machine & Foundry Company, Cleveland, O., manufacturers of power transmissions machinery, announce the opening of a Metropolitan district office at 30 Church street, New York, in charge of Charles C. Phelps, sales engineer.

A new glass decorating factory is reported under construction at Byesville, O., by Earl Martin, formerly in charge of decorating at the Cambridge Glass Company, Cambridge, O. The plain glassware for decorating will be shipped in from outside factories.

The American Window Glass Company is beginning production in the tank at factory No. 4, Bellevernon, Pa. The factory had been shut down for over four years and recently has been converted into a Fourcault plant with a large production capacity.

Ball Brothers Company's plant at Hillsboro, Ill., has resumed operations. The plant was closed down about eight months and there had been a local feeling that it would never be re-opened. The Hillsboro plant will manufacture containers used by candy factories.

The Libbey-Owens Sheet Glass Company, Toledo, O., declared a regular quarterly dividend of $1.75 per share on the outstanding preferred stock and 50 cents per share on the outstanding common stock, payable March 1, 1928, to stockholders of record at 3 o'clock, February 20, 1928.

The Louie Glass Company, Weston, W. Va., is reported to have acquired the stock in the Weston Glass Company of the same city. The corporate names of the two companies will remain unchanged and they will be under the management of Louie Wohinc, president of the Louie Glass Company.

The Condie-Bray Glass & Paint Company of St. Louis, Mo., has discontinued its business in Kansas City, Mo., and will handle all business hereafter from its St. Louis office. The company will not relax its efforts throughout the middle west and believes the change will enable it to follow up its business even more closely than heretofore.

Kauffeld Glass and Ceramic Company, succeeding the L. Kauffeld, Jr., Illuminating Company, Star City, W. Va., has, it is reported, applied for a new charter and will add $150,000 in preferred stock to its capital. Enlargement of the plant at Star City will be made and the manufacture of ceramic slabs under the trade name of "Marbyl" will be started.

The Flat Glass Credit Control Bureau was organized at a meeting in New York on February 9, presided over by R. Cantor of the Royal Glass Works, who was elected temporary chairman. The association will collect information on buyers' financial reputations and credit and distribute it to the members. Applications for membership were received from numerous jobbers.

The Mississippi Wire Glass Company's plant at South Morgantown, W. Va., began heating up their tanks on February 16. Operations at about 50 per cent full capacity of the plant will be started as soon as possible. About 100 men will be added to the force. The plant has been idle for a year or more. A large stock of glass was on hand which has been mostly shipped out during the year.

The Federal Court at Pittsburgh, Pa., has appointed H. C. Burchinal, J. H. Beal, Jr., and Alfred Martin, to be receivers for **C. L. Flaccus Glass Company,** Tarentum, Pa. The assets of the company as given in the complaint total $1,187,239 and liabilities approximate $475,000. The action resulted from a suit for $47,834 filed by the Diamond Alkali Company, Pittsburgh, Pa., and another for $9,000 by J. W. Wilson Company of New York.

Hendrick Manufacturing Company, Carbondale, Pa., manufacturers of factory equipment, including Mitco interlocked steel grating, stair treads and armorgrids, announces the opening of a Chicago District office, 223 Railway Exchange Building, Chicago, in charge of Lon Sloan. Mr. Sloan's extensive floor grating experience is available to those concerned with the selection of floor grating, stair treads and armorgrids for reinforcing concrete floors, platforms and driveways in factories and elsewhere.

The Simplex Engineering Company, Washington, Pa., according to local newspapers have been breaking records for rapid tank building. The Dunkirk (Indiana) News reports that a 70-ton Simplex tank was constructed at the Hart Glass Company, ready for firing in thirty days. The work was done under the supervision of Olin Grieb, field superintendent, and three eight-hour shifts were employed. Another report tells of the construction of a 20-ton tank and a building over it completed for the Federal Glass Company at Columbus, O., in 30 days.

The Sheffield Glass Bottle Company's plant at Sheffield, Pa., is being repaired and the melting tank rebuilt. Operations will be undertaken by a new organization under the management of R. R. Underwood of the **Knox Glass Bottle Company** which operates plants in Knox and Marienville, Pa. It is reported that the Wilcox plant of the Sheffield Company will not start operations at this time. The Marienville plant of the Knox Company has resumed operations after a shutdown for repairs and additions which will double the capacity of the factory.

The Fairfield Sheet Glass Company, Lancaster, O., which operate the Libbey-Owens process and has been closely associated with the Libbey-Owens Sheet Glass Company, Toledo, O., has been sold to the latter company. The stockholders in the Fairfield Company were: H. B. Peters, president and treasurer; George P. Rising, secretary; Leopold Mambourg, general manager; A. G. Vance and P. L. Schneider. The plant has recently had its capacity increased very considerably and further expansion will, it is reported, be made under the new ownership. It is said that Mr. Mambourg, although no longer a stockholder, will retain his position as general manager.

The Harding Glass Company, Fort Smith, Ark., is expending approximately $225,000 on improvements and new machinery. According to W. E. Harding, contracts have been let for all of the work and it is expected that operations in the new plant will begin in June. The installation of sheet drawing machinery similar to the Fourcault process is being made. The Fort Smith Structural Steel Company is erecting a new steel building; Pittsburgh Plate Glass Company, Refractory Department, has the contract for the necessary refractory work; Laclede-Christy Clay Products Company, for fire brick; Southern Securities Company of New Orleans, sprinkler system, and the supervision of furnace construction is in charge of the Hart Brothers Machine Company. Clarksburg, W. Va.

Personals

Paul W. Jenkins of Macbeth-Evans Glass Company, Charleroi, Pa., was elected to the board of directors of the Artistic Lighting Equipment Association at its annual convention held in Cleveland late in January.

Judge I. G. Jennings, business manager of the Glass Container Association, gave a radio talk a few weeks ago from station WRNY, Hotel Roosevelt, New York, on the origin and history of glass. This was one of a series of "Little Journeys into Big Industries" being broadcast from this station.

Harry C. Sorden, secretary of the National Association of Mirror Manufacturers, announced early in February that he now has his family with him at Chicago, Ill., at his residence 3300 Sheridan Road, where he will be glad to see members of the Association at any and all times. His telephone number is Lake View 8625.

Fred S. Thompson, who for several years has been connected with the General Electric Company in its incandescent lamp department, was appointed early in February to be sales engineer of the Corhart Refractories Company, Louisville, Ky. Mr. Thompson was present at the recent annual meeting of the American Ceramic Society at Atlantic City where the company's products were displayed.

Francis Redfern, director of John Walker & Sons, Ltd., London, England, and inventor of the new British 15-arm suction bottle making machine recently placed on the market after undergoing development during the past ten years, recently arrived here from his home country with Sidney Hunt of the same organization, for an extended tour through the bottle manufacturing districts of North America. This company manufactures the bottles used in its large distilleries. The first plant visit was to the Peerless Glass Company, Long Island City, of which John Ohmeis is president, Frank Meng, vice-president, Albert Ludorff, secretary, treasurer and general manager, and A. Crownover, factory manager.

Recent Deaths

Simon H. Stupakoff, Sr., president of the Stupakoff Laboratories, Pittsburgh, Pa., died at his home on February 18.

The Earl of Oxford and Asquith, who as Herbert H. Asquith was Prime Minister of England during part of the World War and who died on February 15, was a director in Redfearn Brothers, Ltd., Old Mill Glass Bottle Works, Barnsley, and the Aldham Glass Bottle Works Company, Wombwell, near Barnsley, England.

Coming Meetings

The American Ceramic Society's European tour will cover the period from May 19 to July 5, 1928, and will include visits to England, Germany, Czechoslovakia, France and Holland The 1929 annual convention of the Society will be held in Chicago.

The Materials Handling Division of the American Society of Mechanical Engineering will hold its first national meeting in Philadelphia on April 23 and 24 at the Hotel Benjamin Franklin.

The American Refractories Institute will hold its annual meeting at White Sulphur Springs, W. Va., on May 16 and 17, 1928.

Inquiries Received

For further information address THE GLASS INDUSTRY

404. (From Roumania) We expect to reorganize our factory and would like to get in touch with concerns manufacturing the most up-to-date bottle making machines and other equipment. (Jan. 18)

405. (From Mexico) I would like to obtain quotations, full particulars and catalogs of machinery for making pressed glassware (Jan. 28)

406. Can you give me a list of concerns from which I could obtain containers for bottling bath salts. (Feb. 15)

What the World Wants

Specific Inquiries for American Goods, Received in the Department of Commerce, Washington, D. C.

South Africa: 29111, pressed glass.

Belgium: 29137, glassware-manufacturing and electric-lamp manufacturing machinery.

Cuba: 29252, glass milk bottles.

Philippine Islands: 29323, glass fruit jars.

Colombia: 29476, electric-bulb manufacturing machinery.

China: 29407, glass bottles.

Spain: 29481, plate glass.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, FEBRUARY 20, 1928

Reported by Moore, Leonard & Lynch, Union Trust Bldg., Pittsburgh, Pa.

	Bid	Asked	Low
American Window Glass Machine, com....	..	16	16
American Window Glass Machine, pfd....	35	..	35¼
American Window Glass, pfd.....	85	..	85
U. S. Glass.....	15	..	14½
Pittsburgh Plate Glass, com.....	..	..	220
Standard Plate Glass, com.....	..	..	5¼
Standard Plate Glass,			
Preferred cumulative	15	..	15
Prior pfd.	..	..	32

TOLEDO, O., FEBRUARY 20, 1928

	Bid	Asked	Last
Owens Bottle, pfd.....	115	..	116
Libbey-Owens Sheet Glass, Com.....	114	..	119
Libbey-Owens Sheet Glass, pfd.....	114½	..	116½

WHEELING STOCK EXCHANGE, FEBRUARY 20, 1928

	Bid	Asked	Last
Hazel-Atlas	79	80	80
Imperial	..	..	72
Fostoria	208	..	208
Central	..	..	75
Jefferson, pfd.....	..	..	96

READERS WANTS AND OFFERS

FOR SALE—One, William Miller, model "P. C.", eight (8) mold milk bottle machine. This machine was used only 2½ years on heavy bottles. The cages are all new; the machine is in good operating condition. This machine can be bought at a very fair price. Further particulars may be obtained by corresponding with the BUCK GLASS COMPANY of Baltimore, Md.

GLASS MAN WANTED—Opportunity for an experienced man to take charge of manufacturing opal and colors, must know tanks and lehrs and all other operations thoroughly. Must be able to assume full charge of manufacturing. In reply state age, education and experience. Address: O-2, care The GLASS INDUSTRY, 50 Church Street, New York.

FOR SALE

2 Wellman-Seaver-Morgan Company gas producers, steel building, coal crusher, conveyors, gas lines, clean-out and boilers. Operated only a short time. A real bargain.

G. S. Frum, 451 South Chestnut Street,
Clarksburg, W. Va.

For Sale: CULLET of all Descriptions
Free from Caps, Wires, etc.
GEORGE F. BAUMANN, Dealer,
1110 Carroll Street, Brooklyn, New York.
Carloads Ready for Immediate Shipment.

WANTED, BACK NUMBERS of The Glass Industry, January, 1927, Vol. 8, No. 1; July, 1924, Vol. 5, No. 7; January, 1923, Vol. 4, No. 1. Premium offered. Send particulars to 50 Church Street, New York.

SITUATION OPEN—See second page following.

Current Prices of Glass-Making Materials

February 20, 1928

Quotations furnished by various producers, manufacturers and dealers

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.44½	.44½
Hydrochloric (HCl) 20° tanks, per 100 lb.	lb.	..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.	lb.	5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	.35	.35
Alcohol, denatured	gal.	..	.48½
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb.	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.20
Ammonia water (NH_4OH) 26° drums	lb.	.03	.03¼
Antimony, metallic (Sb)	lb.	..	.10¾-.11
Antimony oxide (Sb_2O_3)	lb.	..	.14-.16
Antimony sulphide (Sb_2S_3)	lb.	..	.13
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.04¼-.04½
Barium carbonate ($BaCO_3$)			
Precipitated	ton	53.00	58.00
Natural, powdered, imported	ton	48.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05	.05½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.03¾	.04-.04½
Boric acid (H_3BO_3)	lb.	.08-.08¼	.08¼-.09
Refined	lb.	.08-.08¼	.08½-.08¾
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.10-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.27	.28
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25-.30
Black prepared	lb.	..	.30
Cryolite ($Na_3Al\ F_6$) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Artificial or Chemical	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.30
Feldspar—			
100 mesh	ton	13.00-20.00	15.50-22.00
80 mesh	ton	11.75	14.50
40 mesh	ton	11.00	13.50
Fluorspar (CaF_2) domestic, ground, 95-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	.08¾	.09
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.03¼-.07
Black (FeO)	lb.	.03½	..
Kaolin (f.o.b. mine)	ton	9.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.08¾-.10	.09¾-.10¼
Litharge (PbO)	lb.	.07¾-.09	.08¾-.09¼
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	11.50-12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls. Per bbl.		2.15	2.30
Limestone ($CaCO_3$)		2.00	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.08
Manganese 85% (MnO_2)	lb.	.04	.04½
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	23.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08	.08½
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	06⅝	.07⅛
Hydrated 80-85%	lb.	.06	.06½
Potassium chromate (K_2CrO_4)	lb.	..	.28
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.05⅞-.06
Potassium permanganate ($KMnO_4$)	lb.	.15	.15½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.23
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.40⅜-.42⅜
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½	..
In barrels	Per 100 lb.	1.55-1.57½	2.40
In bags	Per 100 lb.	1.37½-1.40	..
Spot orders..02½-.05 per 100 lbs. higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¼	.06⅜
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	3.35	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04½
95 per cent	Per 100 lb.	2.30	2.75
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.04½	.05
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.25
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.39	.41½
Tin oxide (SnO_2) in bbls.	lb.	..	.58
Uranium oxide (UO_3) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.25-2.25
Zinc oxide (ZnO)	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS Corrected to January 24, 1928	December 1926 Quantity	December 1926 Value	December 1927 Quantity	December 1927 Value	Twelve Months Ending December 1926 Quantity	Twelve Months Ending December 1926 Value	Twelve Months Ending December 1927 Quantity	Twelve Months Ending December 1927 Value
Glass and glass products (total)	.....	719,942	.....	739,031	.....	9,171,092	.....	8,880,559
Plate and window glass—								
Window glass, common, box 50 sq. ft.	2,185	17,101	681	5,400	30,976	184,206	21,165	118,125
Plate glass, unsilvered, sq. ft.	36,261	12,460	98,696	39,732	855,157	243,371	1,081,239	347,164
Other window and plate glass lbs.	355,957	25,169	595,059	36,876	3,026,006	271,941	4,415,066	433,582
Glass containers (bottles, vials and jars)	.....	197,166	.....	253,681	.....	3,103,944	.....	3,076,890
Table glassware, plain	.....	143,346	.....	120,398	.....	1,662,342	.....	1,440,274
Table and other glassware, cut or engraved	.....	9,933	.....	13,466	.....	171,925	.....	142,731
Lamp chimneys and lantern globes lbs.	165,306	31,912	148,945	28,354	2,033,812	385,994	1,911,491	388,250
Globes and shades for lighting fixtures lbs.	177,289	60,558	140,784	49,802	1,777,532	598,210	1,668,690	610,738
Chemical glassware lbs.	19,026	16,910	17,451	16,841	226,683	205,854	213,997	194,272
Electrical glassware, except for lighting lbs.	222,143	36,518	121,506	14,702	4,881,273	485,593	2,240,263	236,824
Other glassware	.....	168,869	.....	159,779	.....	1,857,712	.....	1,891,709
IMPORTS **Corrected to January 24, 1928**								
Glass and glass products	.....	1,717,876	.....	1,369,931	.....	20,874,541	.....	17,033,027
Cylinder, crown and sheet—								
Unpolished dut. lb.	7,921,428	284,704	.....	.....	81,633,934	3,191,238	.....	.....
Weighing less than 80 pounds per case dut. lb.	.....	.....	3,723,896	116,935	.....	.....	45,984,107	1,226,473
Weighing 80 pounds or over per case dut. lb.	.....	.....	1,988,878	121,426	.....	.....	36,763,403	1,635,298
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	52,385	.....	38,561	.....	548,269	.....	392,444
Plate glass dut. sq. ft.	2,340,165	767,160	.....	.....	26,664,263	8,851,736	.....	.....
Polished, unsilvered dut. sq. ft.	.....	.....	1,037,580	271,558	.....	.....	15,409,085	4,309,713
Other dut. sq. ft.	.....	.....	128,941	40,162	.....	.....	1,377,395	332,060
Bottles, vials, jars, demijohns and carboys, molded or pressed dut.	.....	18,875	.....	17,533	.....	255,090	.....	192,699
Table and kitchen utensils dut.	.....	22,660	.....	26,384	.....	117,818	.....	200,078
Glassware, cut or decorated dut.	.....	241,476	.....	290,124	.....	2,939,436	.....	3,750,568
Blown glassware, n. e. s.— Bottles, ornaments, gauge glasses and other n. e. s. dut.	.....	57,625	.....	168,431	.....	1,865,455	.....	1,863,442
Bulbs for electric lamps dut. No.	1,096,244	11,507	1,470,400	15,251	18,423,972	207,153	15,126,726	158,814
Chimneys, globes, shades, prisms and other illuminating glassware dut.	.....	103,803	.....	76,182	.....	1,024,803	.....	968,046
Articles and utensils for chemical, scientific, and experimental purposes dut.	.....	38,859	.....	58,463	.....	532,401	.....	537,122
Other glassware dut.	.....	118,822	.....	128,921	.....	1,341,142	.....	1,466,270